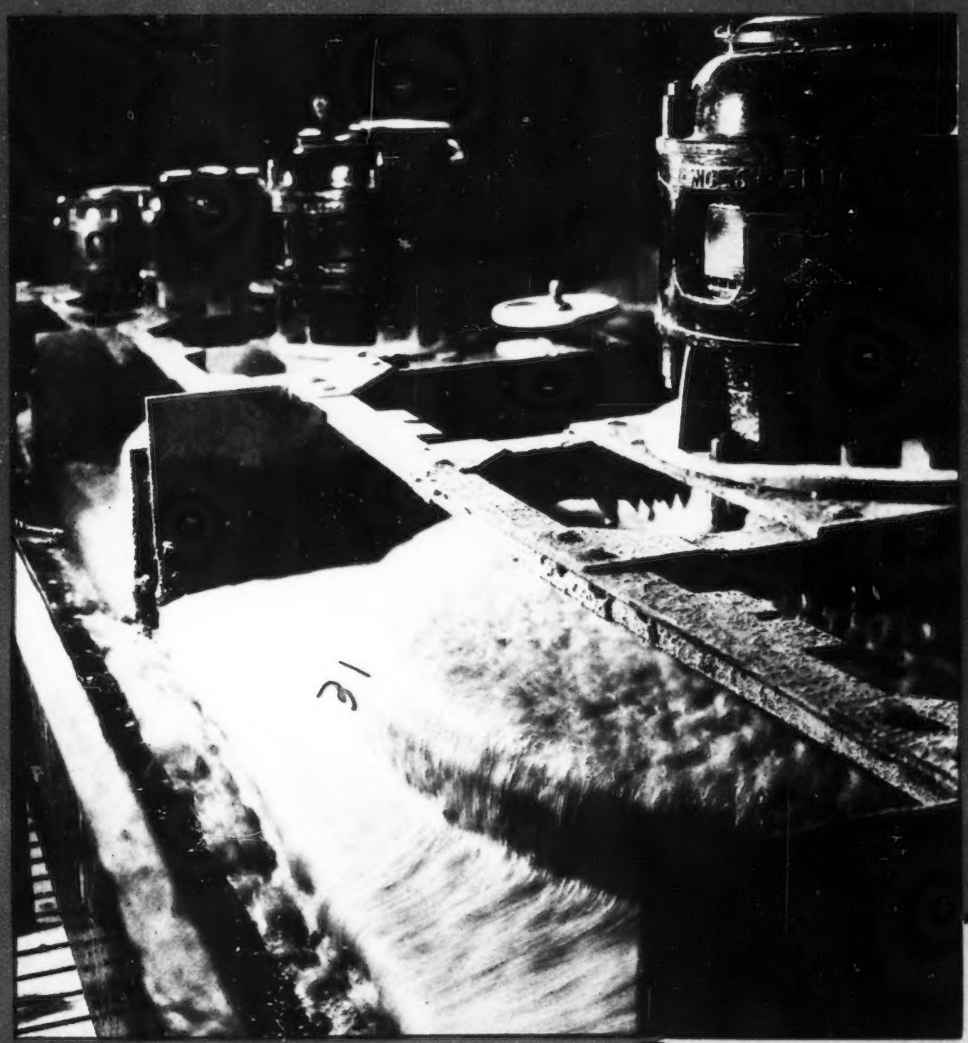
ENGINEERING AND MINING JOURNAL

JANUARY, 1941



Fagergren cells in cyanidation-flotation plant of Wright-Hargreaves Mines, Ltd., at Kirkland Lake, high in rank among gold producers of Canada

In this issue

Grinding Barytes Selectively
Drill-Steel Shanks and Striking Faces
Phosphate in Tennessee • Steel Headframe for Small Mine
Iron Country Jottings • Quicksilver Mining Thrives (photos)
Indo-China's Mineral Wealth
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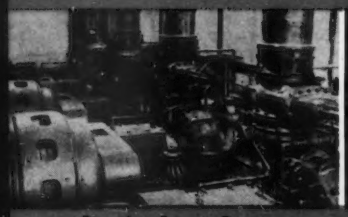
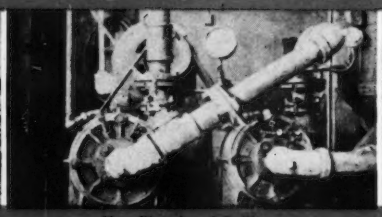
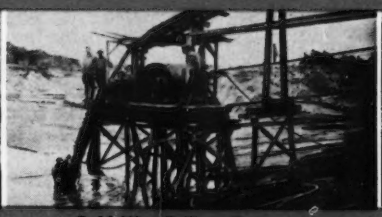


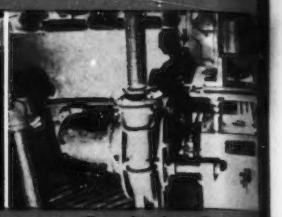
Pumping Copper Ore



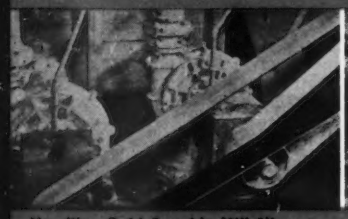
Handling Lead Tailings



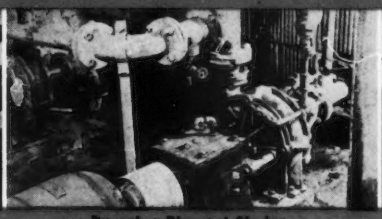
Gold Mine Tailings Recovery



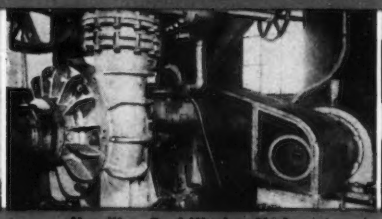
Pumping Iron Concen



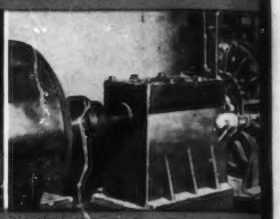
Handling Gold Cyanide Mill Slime



Pumping Pigment Sludge



Handling Coal Washer Sludge



Slag Quenched Sl

SAUCE FOR THE GOOSE–SAUCE FOR THE GANDER

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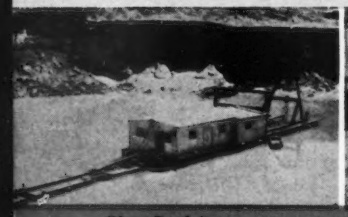
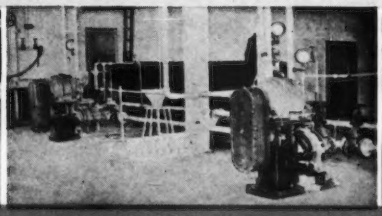
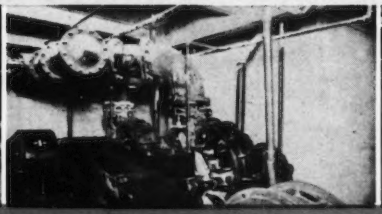


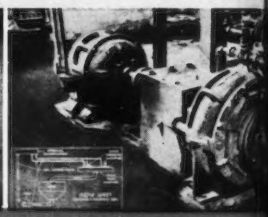
River Dredging



Pumping Oil Refinery Clay Slurry



Handling Cement Slurry

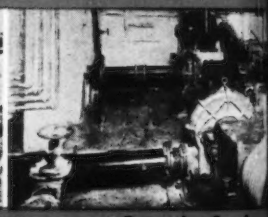


Recirculating Glass Grinding

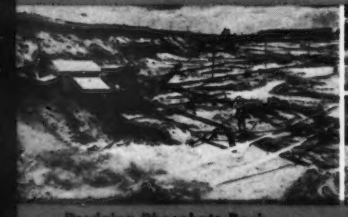
Coal Mine Rock Refuse Disposal

Pumping Coal Mine Rock Refuse

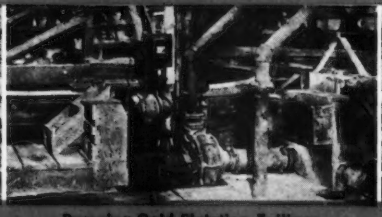
Pumping Silica Sand



Conveying Sand

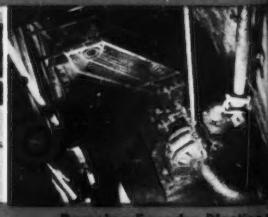


Dredging Phosphate Rock

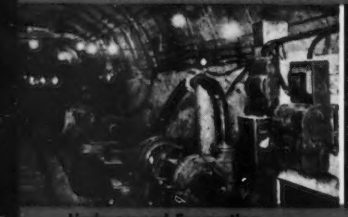


Pumping Gold Flotation Tailings

Cement Slurry Recirculation

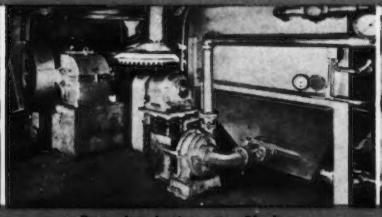


Pumping Foundry Blasting

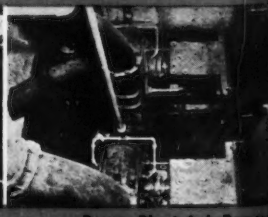


Underground Excavating

Moving Coal Storage Pile



Pumping Incinerator Sludge



Power Plant Ash Remo

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Next month, *E.&M.J.*'s 72d Annual Survey and Outlook Number will make its bow. Those familiar with the corresponding issue of recent years will know that it alone is worth the price of a twelve-months' subscription, a statement for which the editorial staff makes no apology. In character, it will be like its predecessor of last February. In appearance, it will be only slightly different, just enough to prevent subscribers from mistaking it for something they have already seen. Besides surveying the 1940 situation at the mines, in the metal markets, and in the progress of technology, it will serve as a work of reference for the rest of the current year, particularly as to metal prices. And let readers take a tip—the February Survey and Outlook Number is one that is always speedily exhausted, no matter how many have been ordered from the printer. Additional copies wanted should be requested in advance at the earliest possible date.

▼

Coming, at an early date—two articles on the mine and plant respectively of the Union Potash and Chemical Company, the latest entrant into the Carlsbad field of southeast New Mexico. A subsidiary of the International Agricultural Corporation, whose phosphate operations in south-central Tennessee are currently described, the Union company has an important and interesting story for the reader.

▼

And still another word about a non-metallic mineral and an interesting process applied in beneficiating it—namely, phosphate rock and, as for the process, electrostatic separation. Herbert Banks Johnson, whose articles on the process mentioned were published in these pages in the issues of September, October, and December, 1938, has been engaged since then in applying electrostatic separation in treating phosphate. An account of this work will be published in March.

H. C. PARMELEE
Editor

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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COVER ILLUSTRATION: Fagergren cells in cyanidation-flotation plant of Wright-Hargreaves Mines, Ltd., at Kirkland Lake, high in rank among gold producers of Canada

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Volume 142 JANUARY, 1941 Number 1

All Out for National Defense

THE YEAR 1941 opened on an ominous note in the United States. The President's courageous and forthright speech of December 29 still echoed in the minds of the people. The Seventy-seventh Congress convened soberly in the shadow of a great national crisis, with the threat of becoming actively engaged in another World War more menacing than ever. Not exactly an atmosphere of holiday happiness, although New Year's Eve merrymakers probably were unusually noisy and demonstrative. Glad to see 1940 die, they momentarily gave little heed to the serious aspects of 1941.

And yet the vital need of the moment, as we see it, is for all the people of the United States to realize that, although not technically at war, their country is committed to a war economy, with all that that implies of sacrifice and dislocation of customary routine. It will be a long time before we again see "business as usual," if for no other reason than that no one knows what kind of an economy will emerge from this disturbance. Production for national defense, which obviously includes all necessary aid to Great Britain, will have first call on all our resources—men, money, materials, and machines—for a long time to come. Only when the issue is victoriously settled for the democracies are we likely to resume anything like normal relationships in a world at peace.

Until then we are, to all intents and purposes, at war; and we shall soon have to begin to pay the price. If anyone doubts the truth of these assertions, let him read again the President's plain talk on national security. True, he said "Our national policy is not directed toward war." But he also added that "We must be the great arsenal for democracy." So we might as well begin to accustom ourselves to a war economy, and concentrate our energies on a program of hemisphere defense and aid to the free European nations resisting aggression.

Preparation for the Peace

AFTER THE WAR, WHAT? With the lessons of World War I still fresh in mind after a lapse of nearly twenty-five years, leaders in business and Government are already trying to anticipate the problems of economic adjustment after the present war is over. Those who are thinking and looking ahead feel that preparation for the peace must be encouraged quite as much as for national defense. In no other way can we cushion our economy against a disastrous post-war collapse.

Evidence of this line of thought is found in the recent proposals of the Federal Reserve system to forestall inflation; in the Government's decision to relieve industry of the cost of constructing munitions plants that will have no peace-time use; in provision for short-term amortization of investment in industrial plants built primarily for national defense; and in the determination of the National Defense Advisory Commission to prevent abnormal increase in the price of commodities. All of these steps reflect intelligent efforts to avoid a repetition of the violent readjustments that followed the last great dislocation.

Now, the mining industry has a large stake in post-war economic stability, and should do everything in its power to encourage it. Look ahead, for a moment, at conditions likely to prevail when peace comes. Mine production probably will be at an abnormally high rate, in excess

of the usual industrial demand. Metal inventories are likely to be high, in the hands of both producers and consumers. A brand-new problem will be faced in the form of Government-owned stocks of minerals and metals, even of such plentiful things as copper. Possibly some form of Western Hemisphere cooperation will bring Latin American minerals into competition with those of North America. About the only factor not likely to pose a problem will be a precipitous decline in prices such as followed the last war.

A favorable element in the domestic situation that did not exist before will be the preparations for national defense. These probably will continue after peace prevails, and will afford an opportunity to curtail production and reduce stocks gradually, thus lessening the shock of readjustment. But full reliance cannot be placed in that eventuality. Current production and consumption must be kept as nearly as possible in balance, so that unwieldy inventories can be avoided. Probably the best aid in that direction for the guidance and protection of both producers and consumers will be monthly publication of detailed statistical information on each important mineral commodity.

Revise the Excess Profits Tax

IT'S AN OLD HABIT to inveigh against taxation. The tax gatherer has never been a popular favorite. But so long as taxes are laid unintelligently, with little reason other than that the Government needs the money, it will be right and proper to make vigorous protest against unwise tax legislation. There is no excuse, even for harassed officials, to take refuge in expedients, or to lay a tax without knowing with some certainty that it will accomplish its purpose without injustice. The current excess profits tax is a case in point. The original House bill was an unintelligible jumble. The Senate version was an improvement, but the bill enacted left much to be desired in justice and equity.

The object of a special tax on excess profits was to prevent companies and individuals from profiting abnormally out of preparations for national defense. We were to have no "war millionaires," as the President put it. With that intent no one could quarrel, even though the probability of acquiring riches seemed rather remote, considering the financial and economic controls that the present Administration exercises over business, and has exercised with increasing severity for the past few years. Nevertheless, the idea of an excess profits tax met with general approval. There was agreement in principle that no one should acquire great wealth out of a national emergency.

But in the hasty process of devising a suitable measure, the law makers did more than lay a tax on profits. They imposed conditions on business under which there may be smaller profits to tax. They created conditions that definitely discourage the investment of capital in productive enterprise. The tax is particularly burdensome in the case of small mining companies—those that are developing new discoveries in the hope of making mines out of prospects, and others that are using their meagre profits to block out enough ore to warrant expansion of plant. The excess profits tax must definitely retard the growth of such enterprises, and ultimately of the mining industry itself.

The technicalities of the Act are too complex and intricate, and the desirable amendments are too numerous, to be discussed here. But we believe there is an intelligent and effective approach to amendment and revision that should be followed by all small-mine operators—and in the United States that means literally thousands: (1) Familiarize yourself with the Act and see just what its effect will be in your case. (2) Take advantage of the expert studies made by the American Mining Congress, and let your Representatives and Senators know that they too may have the benefit of this information. (3) Finally, urge upon your Congressmen the vital importance of amendment at this session of Congress. Only by concerted action of many individuals will a change be accomplished.

HISTORICAL SUMMARY: ENGINEERING AND MINING JOURNAL was founded in 1866 as the *American Journal of Mining*, the title being changed in 1869. Publications with which *Engineering and Mining Journal* has been consolidated comprise: *Coal and Iron Record* (1875); *The Mining Review* (1877); *The Polytechnic Review* (1879); *Mining and Metallurgy* (1902); *The Mining Magazine* (1906); *Mining and Engineering World* (1917); *Mining and Scientific Press* (1922); *Engineering and Mining World* (1932). All rights to the foregoing titles of consolidated publications are reserved by the publisher. . . . . THE FOLLOWING have served as editors in chief of *Engineering and Mining Journal* and its predecessor publications: G. F. Dawson (1866–67); R. W. Raymond (1867–74); R. W. Raymond and R. P. Rothwell (1874–89); R. P. Rothwell (1890–1901); D. T. Day (1901–02); T. A. Rickard (1903–05); W. R. Ingalls (1905–19); J. E. Spurr (1919–27); A. W. Allen (1927–33); H. C. Parmelee (1933—) . . . . THE EDITORIAL STAFF of *Engineering and Mining Journal* comprises: H. C. Parmelee, editor; A. H. Hubbell, H. C. Chellson, associate editors; Walter M. Dake, managing editor; J. H. Edwards, electrical editor; W. N. P. Reed, J. B. Hutti, assistant editors; H. H. Wanders, market editor; G. J. Young, consulting editor.

El Portal mill and Carbonate Hill, looking up Merced Canyon. Mountains in background are Yosemite National Park

A. C. Harding
Mining Engineer, El Portal Plant, Baroid Sales Division, National Lead Company, El Portal, Calif.

Ground Barytes For Weighting Drilling Mud

Selective grinding is used in processing the product of National Lead's El Portal plant

ADVANTAGES, and sometimes the necessity, of using a weighted drilling mud have long been recognized in the petroleum industry. Several weighting materials are available, but the use of ground barite is finding increasing application for this purpose where an inexpensive, heavy mud with non-settling and non-corrosive properties is required. The high specific gravity (4.3-4.6) and the relative softness (2.5-3.5) of barite are natural properties contributed to the ground product. Moreover, the ground barite produced at the El Portal plant of the National Lead Company's Baroid Sales Division is non-settling because of its fine particle size and the incorporation of a small amount of concentrated colloidal suspending agent in the finished product. The advantage of this non-settling property lies in the fact that the barite will not settle out of the mud-fluid when circulation in the well is suspended, even for several months.

The barytes deposits, a mile west of El Portal, lie on both sides of the Merced River. Yosemite all-year highway and the Yosemite Valley Railway also run through the property. The eastern terminus of the railway is El Portal, which is about a mile west of the Yosemite Park boundary.

According to records of the State Mining Bureau, the first production of barytes in California was in 1910, and the deposits on the north side of the river at El Portal were the first, and for several years the only, source of commercial production. The property has been worked continuously since that date and was acquired by the present operators in 1927, when development was begun south of the river. In recent years the property has been the only important producer of barytes in California and the largest one west of the Rockies.

Barite ($BaSO_4$) is a non-metallic mineral of widespread occurrence in the United States. Because it is heavy, it is also known as "heavy spar," and in Missouri, where it is mined as nodular concentrations in residual clay, it is called "tiff." Other forms of occurrence are as gangue mineral in metalliferous veins and as sinters from hot springs. These have not yet proved of commercial importance. As veins in sandstones and rhyolites and as limestone replacements in shales and schists, barite is most important commercially. The deposits at El Portal fall in the latter classification.

Witherite ($BaCO_3$) is much less common and the El Portal property has been known as the only commercial producer of it in the United States.

The genesis of the El Portal deposits is a debatable question, but the limestone replacement theory is now commonly accepted at the property and has been supported by visiting geologists. The barium may have had its original source in the crystalline schists, the original limestone beds, or in the silicates of the nearby granite. Although there is ample evidence to indicate that meteoric waters played an important part in the distribution of the minerals, it is believed that the barium came from an igneous source with the aid of magmatic waters, was absorbed by ground waters, and then deposited under favorable conditions. In the succession of the minerals, first comes the calcium carbonate; second, the replacement of the calcium, molecule by molecule, by the barium, and then the more or less incomplete change of the carbonate to sulphate by surface waters containing the sulphate radical, derived probably from dissolved sodium sulphate which is found abundantly precipitated on local outcrops.

In connection with this theory it is of interest to note that the principal carbonate lens outcrops on the apex of a steep ridge in which the surface waters have not circulated readily near the surface. Along the same ridge, but below the apex, the other lenses contain a much higher proportion of sulphate, and the carbonate lens increases in sulphate content with depth.

The rocks of the region consist of steeply dipping metamorphosed sedimentaries, intruded by the great granite mass of the Sierras. Stringers of a post-mineral intrusion appear as dikes and sills within the area of the metamorphics and in the mineralized zones. The ore deposits occur in two distinct belts along ridges striking approximately north and south and approximately 1,200 ft. apart. Merced River Canyon cuts across both zones. At present operations are confined to the two strongest sections, south of the river in the west zone and north of the river in the east zone.

In each belt the mineralized zone is about 200 ft. wide and the ore occurs as almost vertical shoots or lenses, sometimes apparently completely isolated and sometimes, where the lenses occur in the same plane or horizon, connected by small stringers. The immediately enclosing rocks, forming the walls of the lenses, are siliceous limestones or crystalline schists, often graphitic. Contacts of ore and wall rock are usually sharp, but occasionally interlaminations occur on a small scale.

Both barite, the sulphate, and witherite, the carbonate, occur in varying proportions in all lenses. The lenses on the south side of the river are principally barite, with a negligible amount of witherite, usually a few percent. On the north side the lenses contain a higher percentage of the carbonate and correspondingly less of the sulphate. The two minerals are not as a rule distinguishable by inspection, although the witherite sometimes has a more vitreous luster. The commercial production of witherite has been confined to one lens north of the river in which the barium mineral is almost entirely the carbonate.

Solution cavities or old watercourses, sometimes of considerable extent, are often met in the lenses, usually along the walls and close to the surface. They are sometimes lined with divergent groups of transparent to opaque tabular orthorhombic crystals of secondary occurrence. No twinned crystals of witherite have as yet been observed, probably due to the higher solubility of the carbonate mineral.

On the south side of the river the ore deposits are situated along the crest and eastern upper slope of the ridge, parallel to and running about 1,600 ft. along the ridge, and in elevation varying from 300 to 1,000 ft. above the river. The lower limits of the deposits have not yet been ascertained, but the maximum depth thus far established has not exceeded 250 ft. below the surface. Individual lenses generally range in length between 80 and 200 ft., and in maximum width from 15 to 40 ft. One large lens, however, was glory-holed to a length of 230 ft. and a width of 110 ft.

On the north side the ore zone extends approximately 1,000 ft. along and on both sides of the ridge, varying in elevation between 50 and 600 ft. above the river. The lower limits have not yet been determined for any of the five known lenses. The maximum depth attained is 350 ft. below the surface. Maximum widths for these lenses are between 15 and 35 ft., with the average about 12 and the lengths varying between 100 and 200 ft.

Analysis of an average sample reveals, in addition to the barium constituents, small amounts of silica, calcium and magnesium carbonate, oxides of iron and aluminum, iron sulphide (small crystals of pyrite are infrequently visible in the ore), and traces of strontium, chromium, copper, and manganese. The principle gangue minerals associated with the ore are silica and calcium carbonate, occurring as stringers and horses of siliceous lime.

Mining—The present workings, at opposite ends of the two ore zones and separated by the river and 3,000 ft. of rugged topography, are operated as two mines. They are known as the South Barium mine, which is the largest producer, and the Carbonate Hill mine, north of the river. Access to the ore has been by adits and, thus far, no sinking nor hoisting has been necessary. Drainage and ventilation are natural.

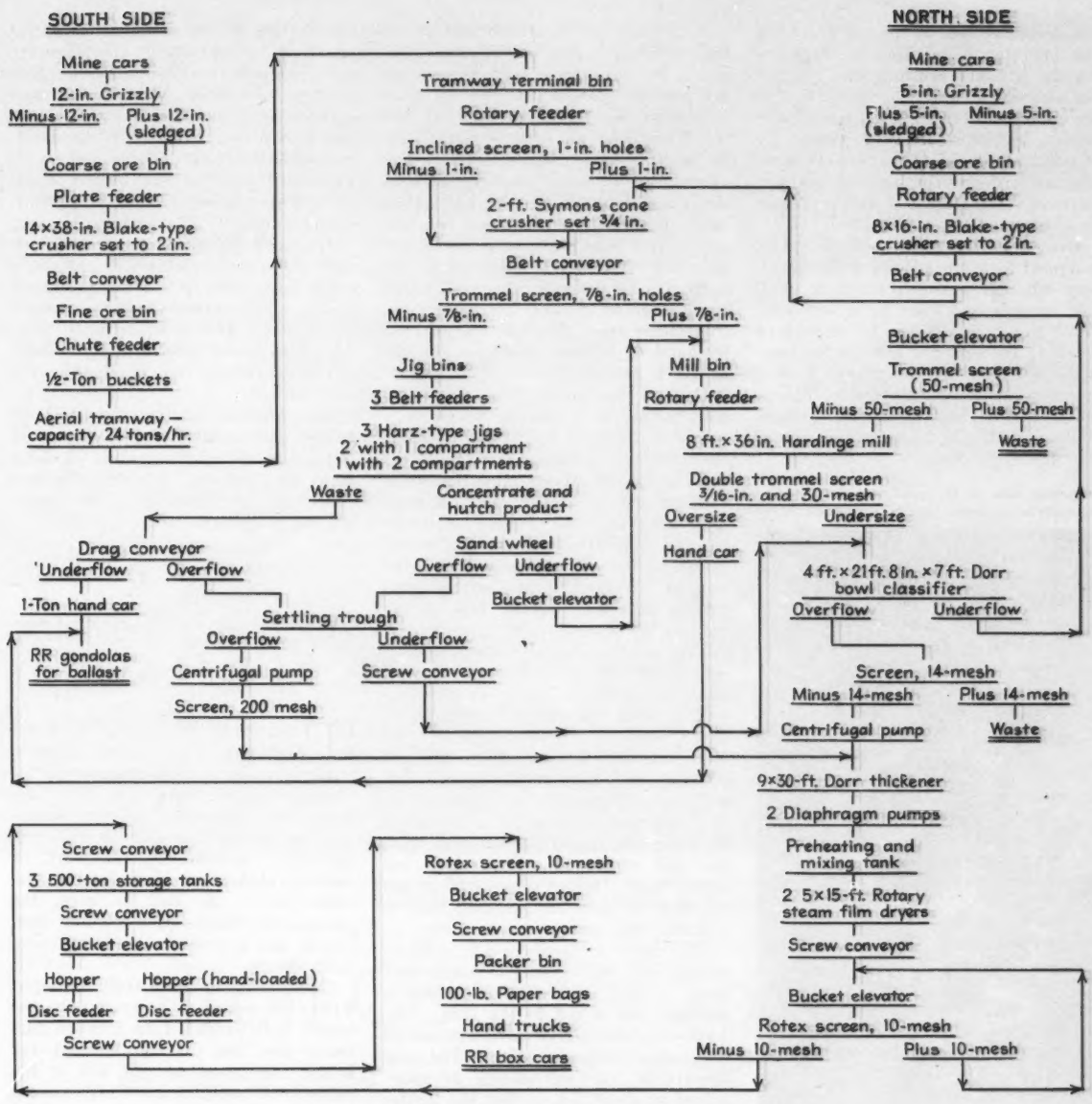
Original operations consisted of quarrying or mill-holing through raises run to the outcrops. Although a limited amount of ore is still being mined from the surface, it consists chiefly of cleaning up old workings and exploring new outcrops before underground mining is begun. In general, the present method of mining is by shrinkage stopes with occasional pillars. Where necessary, crosscuts or raises are run to the ore and the orebody is then explored by drifts and raises. Development drifts are generally 9x7 ft. and are driven along the footwall if the ore is not too wide to prevent reaching the hanging wall with test holes. In wider lenses, drifts may be driven through the center of the ore, and in one case, drifts were driven along each wall with a 20-ft. pillar of ore left between them.

False walls are not uncommon, and both walls are constantly test-holed as a precaution against overlooking a split or a lead to another lens. Blind veins with no outcrops have been discovered when crosscutting and by testing while drifting and stoping. Chute holes are spaced and cut when the dimensions of the lenses have been determined, generally at 12- to 15-ft. intervals along the footwall. Where the width of the ore warrants, chutes are spaced closer and on both sides of the track. Chute holes are cut in ore and the pillars left until the stope has been drawn empty. A ventilation raise is run at one end of the stope and a manway carried at the other.

Ore is broken in stopes with 5-ft. uppers and at each side of the vein the holes are fanned out to the walls from one position of the feed-piston point to facilitate arching the back. A high arch is carried in the wider stopes and little or no temporary support is necessary while working and drilling under the back. The ore, although crystalline, is soft, and sometimes one set of steel will drill a 25- or 30-hole round. In fact, the miners sometimes dull their steel on a grinding wheel in the shop when they contemplate drilling flat holes, so that they will not drill faster than the cuttings can be removed from the hole.

All blasting is done with electric caps, using delays up to No. 10. Current is furnished by transportable sets of two to four 45-v. B batteries connected in series. About 33 percent of ore broken is drawn during stoping, a 6-ft. open space being maintained under the back. No sorting is done in the stopes and little secondary blasting is necessary.

All ore mined from upper working is bypassed through transfer raises or old stopes to the bunker level at each mine. On main haulage levels tracks are 24-in. gage, using up to 40-lb. rails. On other levels tracks are 18-in. gage with 16-lb. rails. Mine cars are trammed by hand. Sixteen-, 20-, and 25-cu.ft. cars are now in use.



Flowsheet of the El Portal barytes plant of National Lead Company

The high specific gravity of the ore permits the 16-cu.ft. (generally not more than a 1 ton) car, to hold 1¼ tons or more, which is an important factor in effecting low costs per ton handled.

Drifting drills of 3½-in. size and 3⅜-in. automatically rotated stoping drills with 1¼-in. round, lugged shank, hollow drill steel are used for development in the hard waste. In the softer ore, 2⅝-in. jackhammers, used as hand-held drills in surface work and on guide shells in drifts, and 2¾-in. hand-rotated stopers in stopes and raises, are used with ⅞-in. hollow-hexagon drill steel.

Compressed air is furnished by two motor-driven compressors, furnishing 550 cu.ft. per minute at the South Barium and 350 cu.ft. at the Carbonate Hill. Steel sharpening and overhauling of machines for both mines are handled at the shop at the South Barium, which is accessible from the highway by a 1,200-ft. inclined, single-rope, electric hoist operating on a 24-in. gage track with 40-lb. rails, a maximum grade of 48 deg., and a total lift of 450 ft.

Drill steel and other supplies for Carbonate Hill workings are conveyed by a small gasoline-powered hoist and carriage with a lift of 150 ft. from the company road to the upper level of the mine.

Milling—Though the flowsheet is relatively simple, consisting essentially of concentrating, grinding, dewatering, and drying, the process offers a few unusual features. Principal among these are exceedingly fine grinding in a ball mill which contains no balls, and the use of the ball mill as a concentrator in a process of selective grinding.

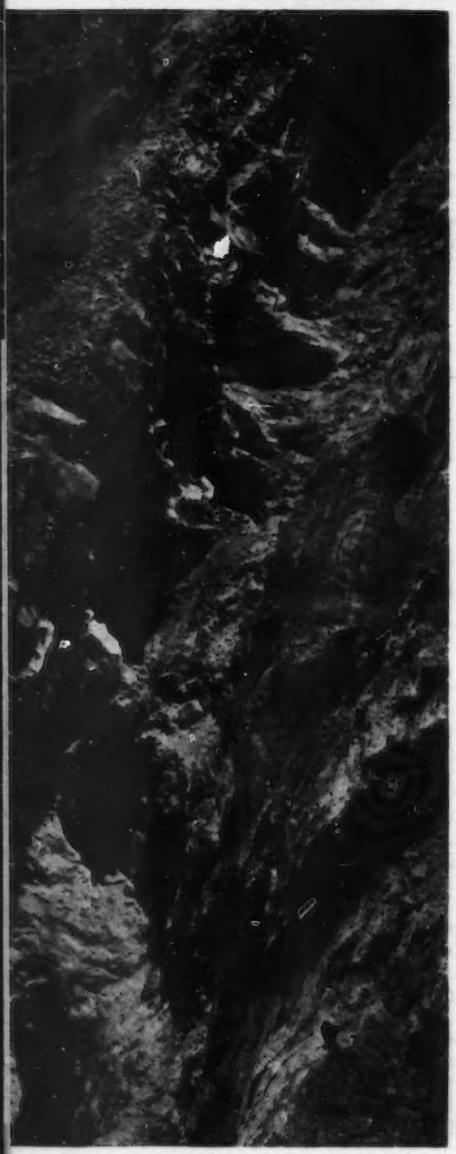
The mill is on the north side of the river, which affords a plentiful supply of water the year around, and adjacent to the railroad tracks, a siding of which is directly accessible from the loading platform at the front of the building. Also, the mill is near the portal and at the same elevation as the main haulage drift on the north side, but necessitates an aërial tramway from the South Barium mine.

The distance over which the tramway operates is 3,000 ft. and the tramway itself is a semi-automatic double-rope type having a capacity of 24 tons an hour, with ¼-cu.yd. buckets. These are automatically tripped into

the terminal bin at the mill. Only one operator is required at the mine for the primary crushing and for filling and dispatching the buckets. The ore is crushed to 2 in., facilitating loading and minimizing the possibility of rock falling out of the buckets while they are crossing the highway and the railroad. The former is also protected by a wire net.

Ore from the north side is hand-trammed to a bin adjoining the tramway bin and passes through a small jaw crusher and then by a belt conveyor to a cone crusher for secondary crushing for either or both of the bins. Separate bins are provided so that shipments of crude carbonate ore can be made from the north side without shutting down the tramway and emptying the larger bin.

This barytes lens at El Portal was first worked as a gloryhole, later as a shrinkage stope



A trommel screen at the head of the mill building makes a separation at ⅜-in., the oversize going to the mill bin and the undersize to the jig bins. In design, the three jigs approximate the Harz type but have been modified to satisfy local requirements. The two oldest have one compartment, and the third, built on the property, has two. Circular lips are used for the concentrate beds, and hutch spouts are manually operated at intervals as required. Jig concentrate and hutch product go to the mill bin to join the trommel oversize. The waste is trammed by hand to railroad gondolas for use as track ballast.

Use of the ball mill as a gravity concentrator is a practice which originated at the El Portal plant and has been termed "selective grinding." In ordinary closed-circuit operation some concentration may result when sulphide minerals are more friable than the gangue minerals, resulting in the sulphides being slimed more than the gangue. Taggart states that this contention has not (1927) been borne out by data and calls the process "differential grinding." The important difference between differential grinding and selective grinding, in my opinion, is that differential grinding, if and when it occurs, is accidental; that both valuable mineral and waste are ground, and any concentration that may take place does so in the classifier, whereas in selective grinding at El Portal the waste is discharged from the mill unground. Experience has shown that a better concentration can be made by selective grinding than is possible with either jigs or tables.

The mill is a Hardinge 8 ft. x 36 in. conical ball mill taking a minus-1-in. feed. Until recently no grinding medium was added to the feed. The barite is exceedingly friable and served as its own grinding medium. The pulp density of the mill charge is maintained at about 3.4, so that the lighter waste floats in the pulp and is discharged unground as quickly as possible. Grinding capacity has recently been improved by the addition of punchings secured from Western fabricators in sizes not exceeding 1¼ in. This maximum size must be mixed with smaller sizes to grind to 300 mesh, as required for the finished product.

A separation of ground barite and coarser waste is made by 3/16-in. and 30-mesh trommel screens attached to the discharge end of the mill. Such waste is used for track ballast. The mill is in closed circuit with a Dorr bowl classifier, an elevator, and a 50-mesh trommel screen. All mill product coarser than 50 mesh is discarded from the circuit.

The ground barite is dewatered in a 9x30-ft. Dorr thickener. Much trouble was had in getting the exceedingly fine material to settle in the thickener tank. This difficulty was overcome by heating the water to about 80 deg. F., lowering its density. The mud is then pumped from the thickener and dried on two rotary steam-heated film dryers, being splashed onto the outside of the 5-ft. drums. When dried, it is brushed off into a screw conveyor. The dried particles are broken down by a Rotex screen before going into storage bins.

The mill building is open on all four sides, and because the process is a wet one, there is no possibility of dust nuisance until the material reaches the packer. This is on an open platform and is well protected by a dust-collecting system, thus eliminating the dust hazard.

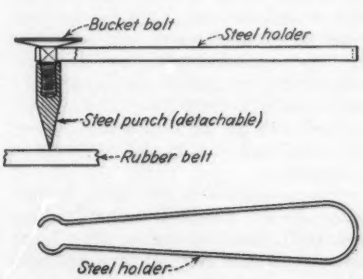
The ground barite is packed in 100-lb. multi-walled paper bags and shipped to all of the various oil fields that are situated in the Western United States, Canada, South America and the Orient.

▼ ▼ ▼

Attaching Elevator Buckets

THE SIMPLE DEVICE developed by W. Cooksley, general foreman at the concentrator of Magma Copper Company, Superior, Ariz., and illustrated in the accompanying self-explanatory sketch, has materially speeded up the work of bolting buckets to new bucket elevator belts. As will be seen, the equipment consists of a pointed steel punch, and a holder resembling tongs in its design.

Operation is relatively simple. First, the punch is screwed onto the bucket bolt proper, then gripped just below the head of the bolt by the holder and placed on the belt at the point to be punched, and finally driven through the belt by a few hammer blows on the bolt head. After the required number of bolts has thus been driven through the belt, the punches are removed and the bucket is attached. The time required by four men to punch a belt containing 68 buckets (7 holes per bucket) prior to the adoption of the device described was about two 8-hr. shifts. Now the job is being done in 25 per cent less time.



At the open-pit iron mine of E. W. Coons Company, Hibbing, Minn. Here the transport facilities include a fleet of Koehring Dumptors, two of which are in the foreground and two in the upper left

Iron Country Jottings

Some notes on current operations viewed as the 1940 shipping season ended

A. H. Hubbell
Associate Editor

EVEN IN A DULL YEAR, when ore shipments are small and the mines and communities alike reflect the dullness, a visit to the Iron Country of northern Minnesota, Michigan, and Wisconsin will reward the visitor. In a busy season, such as the one just closed, its interest for those who would follow iron mining is considerably greater. Here in the Lake Superior region, 150 miles in latitude and more than twice as much in longitude, we have the sources of four-fifths of the United States' output of iron ore, a fact that lends this northern area special dignity and importance. The mines, both open-pit and underground, exhibit up-to-date practice and equipment, always with some interesting experimental work in progress. Likewise the ore-beneficiating plants. One should remember that it was here that power-shovel mining and scraper mucking had their initial great developments, and that there always may be current trends and innovations worthy of attention. Random notes based on a trip that was made during the past November follow:

First a glance at the ore shipments which, as customary, move by boat down the Lakes, the cargoes being loaded at the so-called upper ports of Superior, Duluth, Two Harbors, Ashland, Marquette, and Escanaba. From the first three was shipped more than 70 per cent of the total for the 1940 season. Final figures announced by the Lake Superior Iron Ore Association in mid-December, after shipments had ceased, put this total at 63,352,768 tons, an amount somewhat short of the record because of a lagging start, but promising well for 1941. Of this total, the Minnesota mines shipped 48,474,931 tons, the Mesabi range setting a new record at 45,544,653 tons, mined

largely in open cut. Michigan and Wisconsin mines, mostly underground in contrast, contributed the balance of 14,877,837 tons. (The weather is the principal determinant of the date when shipments via the boats must cease. One company operating a large fleet of ore carriers has generally set its closing around Nov. 20. Its records show that it has closed as early as Nov. 7 and as late as Dec. 22.)

Year by year the percentage of beneficiated ore included in the Minnesota shipments has been increasing. In 1939 it was almost half (48.6 per cent). Just now it is still too early to know the 1940 figure. The upward trend reflects the manner in which the average grade of the ore that is mined has been falling.

In this connection it is interesting—and it should be so to legislators who have so blithely wielded the taxing power—to note that various iron-ore-consuming interests have been looking outside the Iron Country for additional sources of supply of ore requiring beneficiation. Not only has the Republic Steel Company leased the Witherbee Sherman and Chateaugay properties in New York State, but another important operator also is reported to be attracted to New York, and the Inland Steel Company has a low-grade magnetite property at Black River Falls in west-central Wisconsin. On the other hand, the low-grade, hard-to-drill magnetite deposit at Babbitt, Minn., on the eastern end of the Mesabi, is receiving new attention as drilling technique appears improving.

Open-pit transport in the Iron Country continues to command attention. The topic has been discussed from the engineering viewpoint in these pages[1] by L. C. Moore with respect to steam and electric haulage, conveyors and trucks. Incidentally, there are approximately 96 open pits of varying size on the Mesabi and Cuyuna ranges in Minnesota (none on the Vermilion), compared with ten small pits on the Michigan ranges, where mining is chiefly underground. Steam haulage is still predominant, all pits considered, although the installation by one large operator in the 1940 season of ten 1,000-hp. diesel-electric locomotives suggests that the day of the steam locomotive may really be drawing to a close.

Truck Transport—The number of instances where trucks are employed as the principal means of transport or in conjunction with conveyors is as yet relatively small, but it is surely growing. The respective installations at the St. Paul[2], Judd[3], and Spruce[4] pits, on the Mesabi, have already been described; likewise various installations made by Butler Brothers—these[5] in considerable detail. Pickands, Mather & Company are using trucks at three Mesabi mines, the Biwabik, Albany, and Corsica, the ore at the first and second being hauled by truck completely out of the pit, while at the Corsica the trucks deliver to a hopper in the pit bottom, from which point dump-car trains drawn by steam locomotives remove the ore. The Biwabik and Albany installations are practically identical with that at the Mahnomen mine operated by the same company on the Cuyuna range and described by Frank A. Kelley, general superintendent at Ironton of the company's Cuyuna operations, in an unpublished paper presented at the A.I.M.E. meeting in New York last February. Mr. Kelley credits the late W. H. Gallagher, the company's chief mechanical engineer at Duluth, with having worked out the desired combination of specifications to allow a truck with a pay load of 36,000 lb. a speed of 8 miles per hour traveling up an 8-percent grade. The details of this combination have already been published in the *Journal*,[6] the truck produced following the original specifications with but slight changes, one of these being an increase in body capacity from 9 to 9½ cu.yd. The speed actually developed on an 8 percent grade was 10 miles per hour.

Ore-Transport Systems At the Albany Pit

The effect upon layout and operation of an open-pit mine of moderate size that is brought about by replacing locomotive haulage with truck haulage is well indicated by the two accompanying pictures of the Albany pit. These were taken from the same point in 1939 and 1940 respectively. The change-over was made between seasons. It is through the courtesy of Pickands, Mather & Company that we are able to present the views. To permit comparison they are positioned one exactly over the other. Comparative data follow:

In 1939, with railroad haulage, as shown in the upper picture, the trackage from the yards to the pit bottom totaled 11,400 ft., including six switchbacks and the main line. The average grade was 3.6 per cent, compensated 0.04 per cent for each degree of curvature. Three locomotives (20x24-in.) were required per shift and either two 75-ton capacity cars or three 50-ton cars were handled per trip. A seventh switchback was being developed at the time the change to truck haulage was made. Ore shipments with railroad haulage in 1939 from this pit were 323,207 tons.

With the truck installation (seen in the lower view), which was used throughout the 1940 season, the length of truck road from the ultimate pit bottom out to the dumping ramp is 5,200 ft. The grade of the main truck road is 8 per cent, except on curves, where it is dropped to 6 per cent. On the ore benches the grade varies. The average grade from the ultimate bottom to the ramp is 7 per cent. There are seven trucks in the fleet, each of 15 tons' capacity. Shipments from the pit in 1940, using the trucks, totaled 524,742 tons.

The shovel shown in both pictures is a 50-B steam-operated caterpillar-mounted Bucyrus, having a 2-cu.yd. dipper.

Trucks and related equipment in considerable variety are also being used for cleaning up in the larger pits and elsewhere, in places where there is a small but worth-while tonnage of ore so situated that the bigger shovels and cars cannot be put to work on it. Equipment recently noticed on such work included conventional rear-dump trucks, Athey crawler wagons, La-Plant-Choate (and other) wheeled scrapers, and the Koehring Dumptor, a quick-dumping diesel-driven unit that is designed for being shuttled back and forth without turning between loading and dumping points. A not-unusual combination in this clean-up work is a 1½-cu.yd. shovel and two trucks for a 700 to 800-ft. haul.

The advent of truck haulage has brought to the operators the need of knowing how to construct a good road out of a pit, one that is able to withstand the punishment inflicted by heavy trucks, loaded or unloaded. (The truck previously referred to as conceived by W. H. Gallagher is designed for a gross-load capacity of 62,000 lb.) Especially must the portion of the road that is likely to be permanent be well constructed. Both black top and stabilized gravel surfaces are being used, the latter, for example, in the Mahnomen pit, where 3,000 ft. of hard road has been built, the construction procedure being described in the paper by Mr. Kelley[7] already mentioned. One operator, moreover, namely the E. W. Coons Company, of Hibbing, which is also in the contracting business, has built 1,200 ft. of concrete ribbons, 36 in. wide, at its nearby pit to facilitate the movement of its trucks out and their quick return. Its operation is shown on page 37.

Of interest is the extent to which road-maintenance equipment is being adapted to open-pit work. This includes tractors, with and without the bulldozer blade, road graders, and sprinklers, the introduction of such equipment calling for shop changes in some cases to permit its servicing.

Conveyor Transport—Transport by conveyor at open pits of the Iron Country has been limited to four in-

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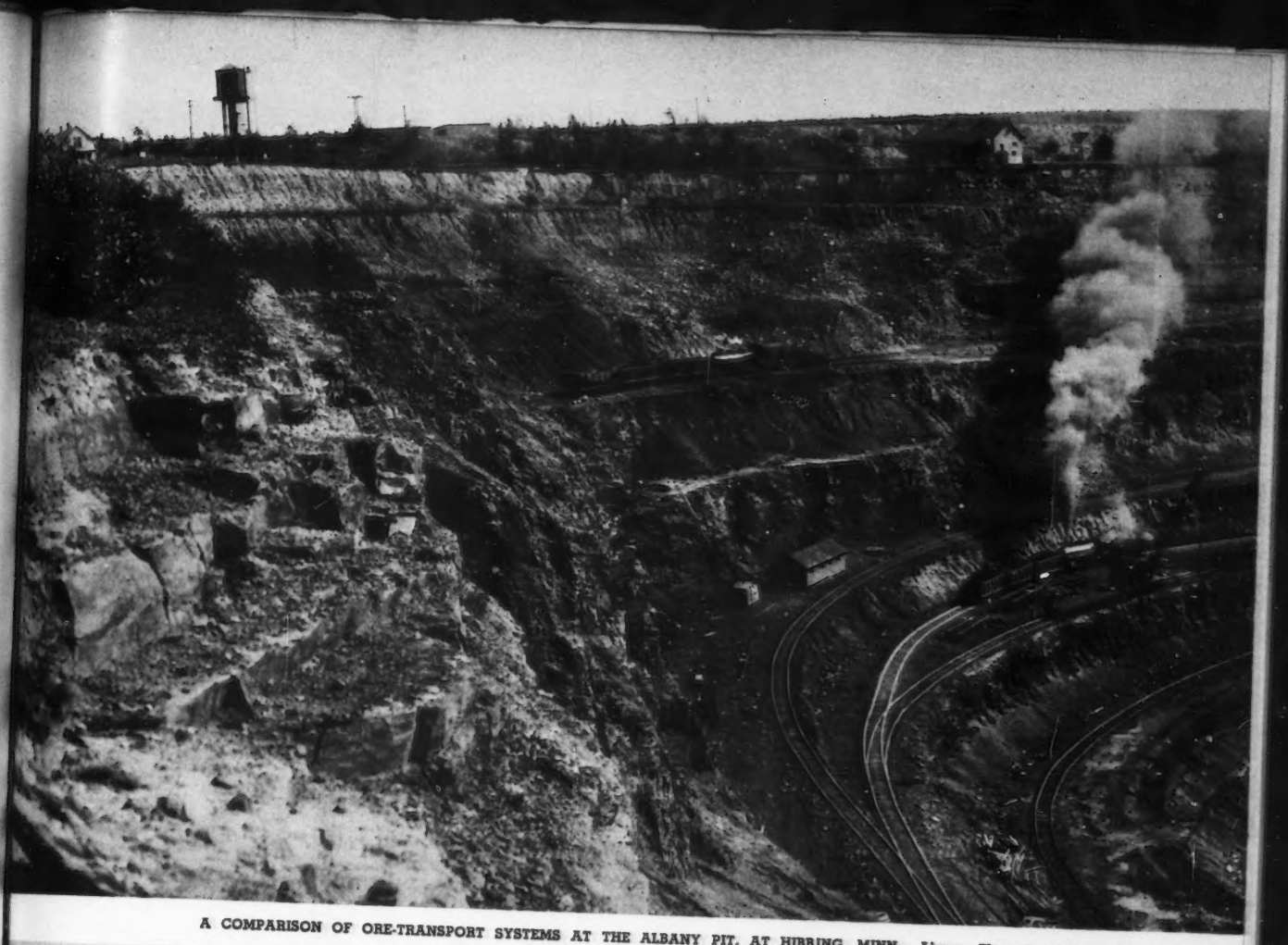
[1] "Open Pit Transport on the Mesabi Range," *E.&M.J.*, Oct., Nov., Dec., 1938; Jan., Mar., July, 1939; and Jan. 1940.
[2] *E.&M.J.*, Dec., 1937.
[3] *E.&M.J.*, Mar., 1938, Charles H. Remer.
[4] *E.&M.J.*, Oct., 1938, L. C. Moore.
[5] *E.&M.J.*, Jan., 1939, R. W. Whitney and Grover J. Holt.
[6] *E.&M.J.*, Jan., 1940, pp. 39-41. "Open Pit Transport VII," by L. C. Moore.
[7] New York Meeting, A.I.M.E., unpublished paper.
[8] It was described briefly by L. C. Moore, *E.&M.J.*, Oct., 1938.

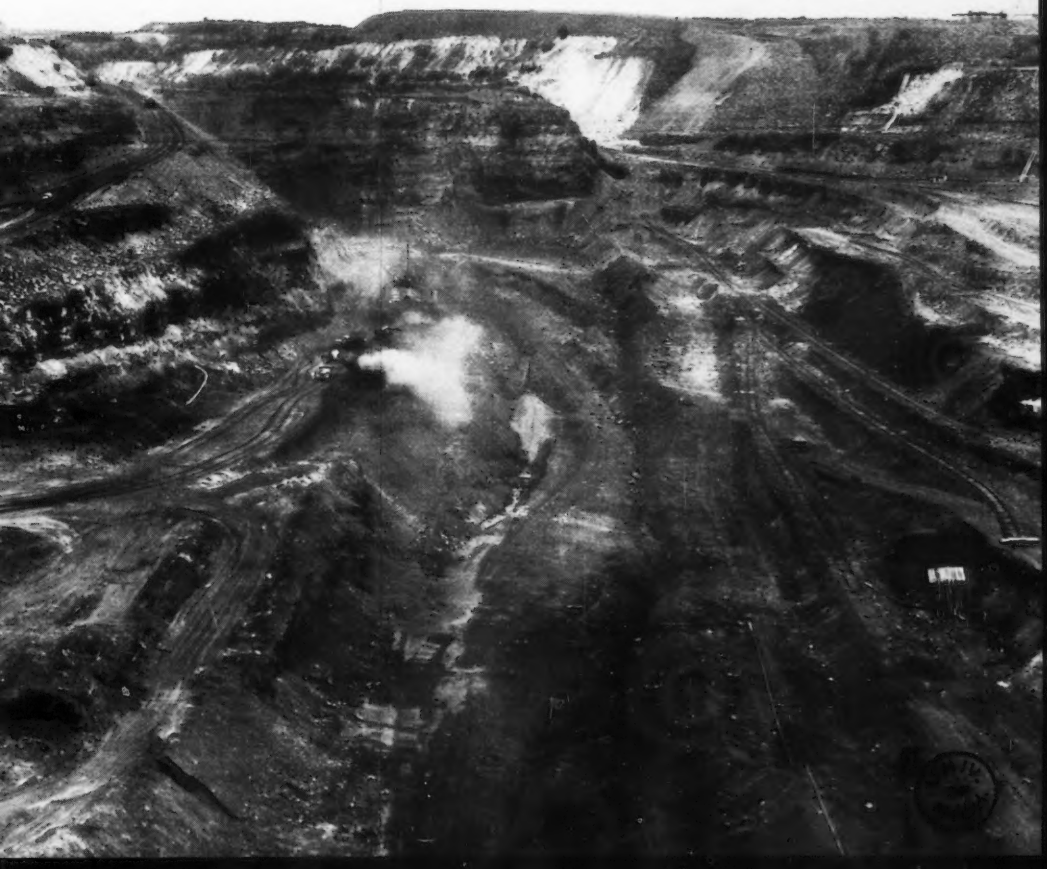


A COMPARISON OF ORE-TRANSPORT SYSTEMS AT THE ALBANY PIT, AT HIBBING, MINN. Above, The pit with steam-operated railro

BBING, MINN. Above, The pit with steam-operated railroad haulage in 1939. Below, The same view in 1

Photos by Schawang, St. Paul, Minn., by courtesy of Pickands, Mather & Company

ne view in 1940, after trucks had replaced the railroad equipment. See the accompanying text



stallations up to the beginning of the 1940 season, these being at the La Rue, St. Paul, Spruce, and Judd pits respectively. The past year saw a fifth installation, which also involves the use of trucks in the pit, placed in operation at Cleveland-Cliffs' Canisteo mine, at the western end of the Mesabi, and by the time the 1941 season is under way Butler Brothers will have conveyors at their Harrison, Kevin and Galbraith pits.

At the Spruce pit of the Oliver Iron Mining Company, at Eveleth, on the Mesabi, during November, the mining and ore transport system, which was installed in 1937 and combines two tower excavators, trucks and 4,500 ft. of 30-in., 7-ply conveyor belt, was being rearranged somewhat by the transfer of some of the units to new locations within the pit because the ore at one end had been exhausted. Basically, the system[a] will be unchanged and it remains a notable installation.

To the Canisteo, with recorded shipments of almost 23,000,000 tons from 1907 up until 12 months ago, the year 1940 brought a decided change. Railroad haulage within the pit gave over to a fleet of Euclid trucks and the big steel concentrator, built in 1929–30 and of a rated capacity of 500 tons of wash ore per hour, was taken down at its site a mile or more away from the pit and reerected at the edge. The ore pocket is down in the pit and is connected with the plant above by a conveyor system consisting of three 36-in. belts totaling 900 ft. in length and inclined at 18 deg. to the horizontal. The trucks remain in the pit, dumping into the pocket. This installation is to be described soon.

As for the conveyors planned by Butler Brothers for the Harrison, Kevin, and Galbraith pits next season, Grover J. Holt states that at the first two they expect to keep the trucks at the bottom of the pit, with a screening plant there to remove the rock. The screened ore will then be transferred up the bank out of the pit by three long flights of conveyor belt, in each case to surge bins. These in turn will discharge into 20-cu.yd. stripping cars, which will be hauled by locomotives to the washing plant.

At the Galbraith, the same procedure will be followed in the bottom of the pit. However, the ore will be transferred all the way to the washing plant by conveyor, which will require six to seven flights of belt. At this property a new concentrating unit is also being built.

Stockpile Loading—Time study data on a new piece of equipment proposed for loading ore and concentrates from stockpiles into railroad cars are worth attention. The equipment, shown in an illustration, was the Athey Mobiloader, Model D8, consisting of a bucket or dipper of 3½-cu.yd. capacity, having a temporary lip extension and with actuating mechanism, mounted on a standard D-8 Caterpillar tractor. The trials were conducted at Butler Brothers' Harrison plant on the Mesabi early in November. The material handled was wash ore concentrates, which were loaded into 75-ton railroad cars spotted parallel with the stockpile and 80 and 90 ft. respectively from the toe of the pile in the two tests made. The tractor thus equipped had to shuttle back and forth at track level over the distance between the stockpile and car. Stockpile height varied from 15 to 40 ft. Both tests were conducted in fair weather at freezing temperature.

On the first test, with 90 ft. to traverse per trip, four cars were loaded, requiring 61 trips. The digging area was restricted. Average load per car was 69.5 long tons, average bucket load per trip 4.41 long tons, and the average round-trip cycle was 0.956 minutes. The best cycle was 0.85 minutes, made up as follows: Loading, 15 seconds; hauling, 18; dumping, 6; returning 12. The material was thus loaded into the cars at the rate of 277 long tons per hour.

On the second test, with 80 ft. to go between stockpile and car, seven cars were loaded, requiring 107 trips, average load per car being 73.1 long tons. Digging area was ample. The average round-trip cycle, deducting one minute from total car time in one case for leveling the runway with the loader and in another case three minutes for checking the oil level in the loader gear case, was 51 sec. Three minimum cycles averaged 46 seconds, thus: Loading, 10 sec.; hauling, 18; dumping, 5; returning 13. The loading rate was 337 long tons per hour.

Drilling—At the machinery exhibit that accompanied the meeting of the American Mining Congress in Colorado Springs last September an electric core drill, using diamond-set bits and apparently not as yet in production, was shown by the Sullivan Machinery Company. It was duly described in *E. & M. J.* Oct., 1940, on page 87. Prolonged tests on drilling blast holes in hard ore with a machine of apparently similar sort, though possibly differing in various construction details, are commonly reported to be under way at an Iron Country mine. Results, while thought to be successful, in a measure at least, have not been divulged for publication.

Detachable bits have come into their own, so to speak, in the Iron Country. Here, in the underground mines, the ore where sufficiently soft is commonly, though not always, drilled with L-section, diamond-twist auger steel. In other ground the detachable bit has largely displaced the regular or sharpened steel, the argument favoring this being based usually on the greater ease with which a supply of bits sufficient for a shift's drilling can be carried to the working face. Both center-hole bits and side-hole bits are not infrequently used in the same mine, the latter where soft ground would be likely to plug up the center hole. Bits are reground, the number of usages thus obtained varying from three to six or seven and occasionally more. Details of practice in respect to normalizing, grinding, tempering, and gaging vary in different mines and are continually changing.

A test with the Athey Mobiloader is here seen under way near the Harrison washing plant of Butler Brothers at Cooley, Minn., on the Mesabi, in November, 1940. Concentrates are being loaded into railroad cars from the stockpile

Drill-Steel Shanks and Striking-Face Failures

OVER a period of years the investigation of replacement claims of rock-drill parts has shown that the proper preparation and maintenance of drill-steel shanks, attention to the component drill parts, and correct procedure in drill operation will give substantial savings in the repair costs of rock drills. Failures of piston hammer or tappet striking faces are perhaps the most serious of these prevalent difficulties and at the same time are most subject to conditions controllable only by the drill user.

Five conditions associated with typical failures of the striking face will be presented, together with photographs, the better to illustrate the cause, condition, and resultant failure in each case.

In Fig. 1 are shown two shanks which display a fair amount of "crown" or rounding of the striking end. This is a condition which always develops with use and requires for its control, periodic examination and repair by grinding, hot-milling, or forging in a shanking cap.

In Fig. 2, is seen the type of contact obtained between such a crowned shank and the face of a new tappet. This condition localizes the contact between the face and shank to a small area immediately surrounding the water-tube hole. By actual measurement, the area of contact resulting from the use of a crowned shank has been observed to be, in extreme cases, only 20 percent of what would have been obtained if the total available area of the shank striking end had been employed, resulting in an intensity of blow on the tappet striking face in the area contacted that is five times the amount which should be imposed. The result of using crowned shank striking ends will be either the development of chipping around the tube hole of the hammer or tappet - striking face, or the formation of a cupped striking face, as demonstrated in Fig. 3. The former, seen at the left, devel-

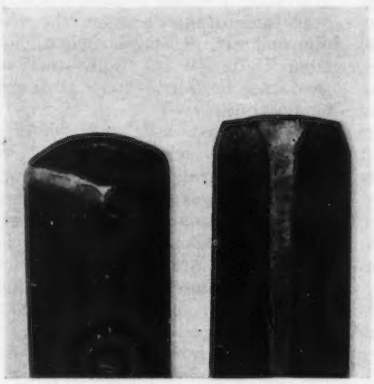


Fig. 1 . . . Crowned or rounded shank ends on 1-in. quarter-octagon drill steel

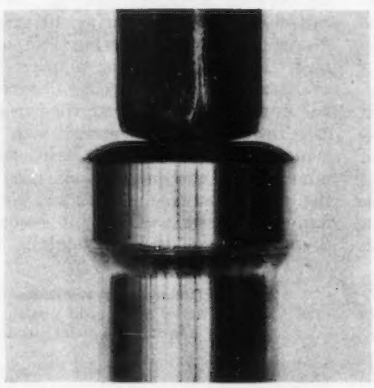


Fig. 2 . . . Contact between a crowned shank and a new tappet striking face

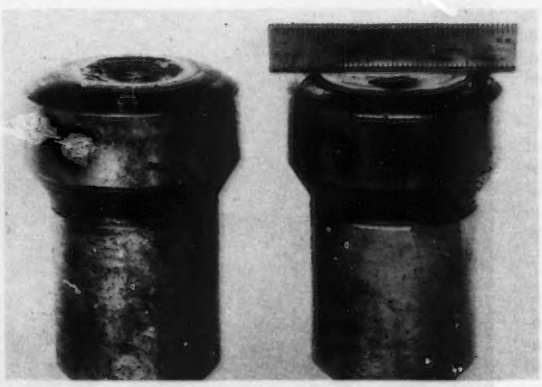


Fig. 3 . . . Two types of failure from using crowned shanks

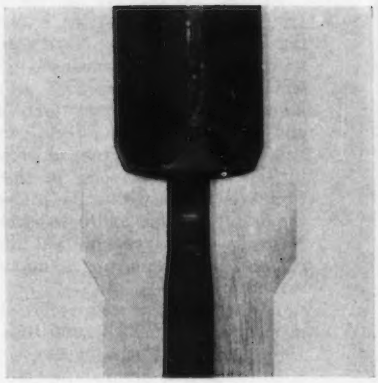


Fig. 4 . . . Contact between a flat shank and a cupped striking face

Fig. 5 . . . Chipping or spalling of a cupped striking face through using a flat shank end

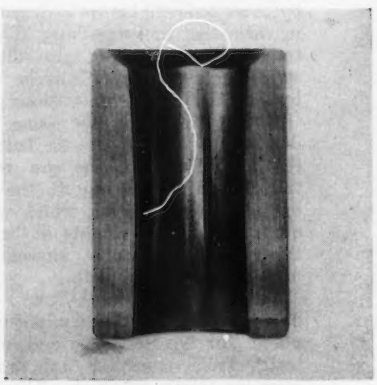


Fig. 6 . . . A badly worn chuck

A relation exists between the two that is dependent in part on the preparation and condition of the former

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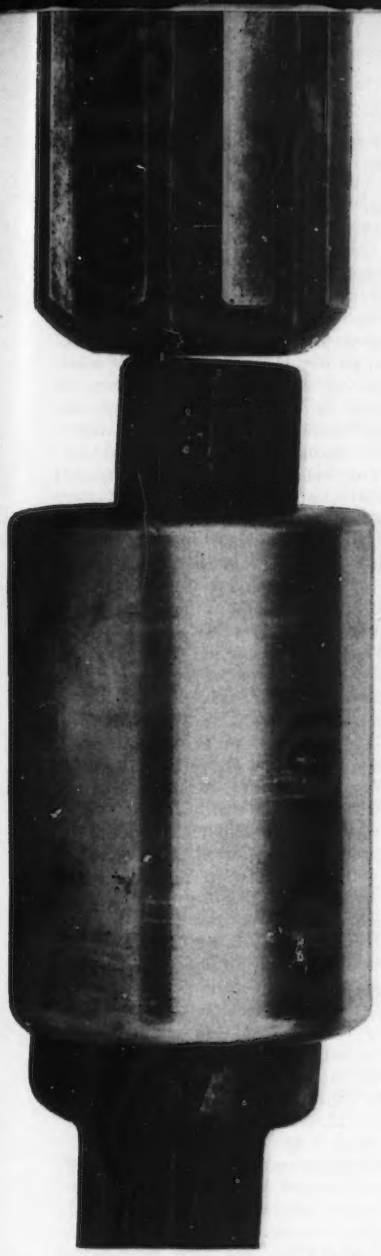


Fig. 7 . . . Contact developed between a flat-faced piston hammer and a properly formed shank when used with a worn chuck

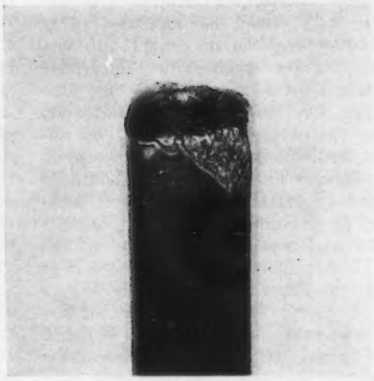


Fig. 9 . . . A badly shattered striking end

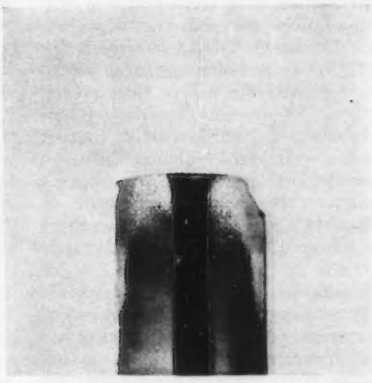


Fig. 10 . . . Etched section of the chipped shank of Fig. 9 showing the excessively hard structure of the striking end

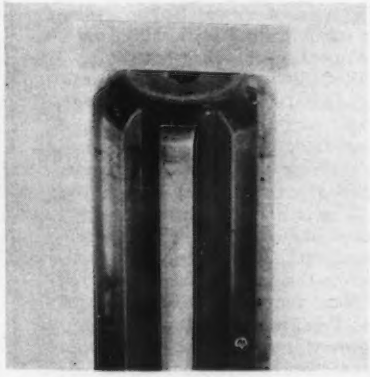


Fig. 8 . . . Failure of striking face resulting from use of worn chucks in conjunction with fairly flat shanks

Fig. 11 . . . Striking face damaged through operation against shanks that are excessively hard

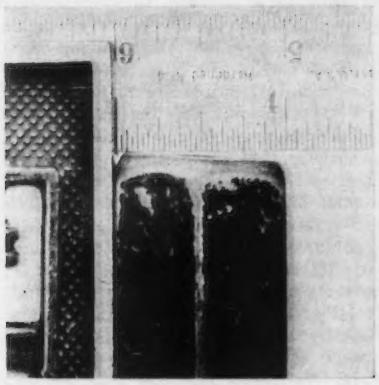


Fig. 12 . . . An off-square shank striking end

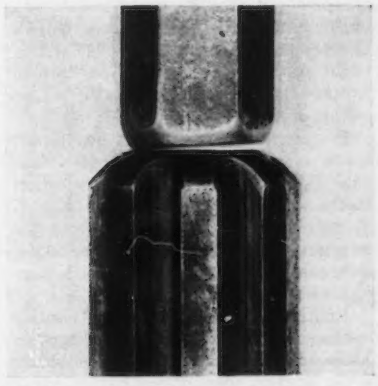


Fig. 13 . . . Showing the contact between an off-square shank end and a new piston hammer

Fig. 14 . . . Clamshell type of piston hammer failure caused by localized and repeated contact by an off-square shank

ops from using badly crowned shanks with chucks that are not badly worn. This combination results in blows of high intensity, due to the limited area of contact, on the center of the striking face, causing early chipping of the area around the tube hole. The type of failure shown at the right of the photograph usually results from the use of shanks only moderately crowned in conjunction with chucks that are somewhat worn. The less extreme crown does not bring about as intense a blow as if it were badly rounded, and, due to the use of the worn chuck, the area of contact shifts about over a larger area. The latter type of failure usually requires a longer time for its development, but the results are equally serious.

In Fig. 4 is shown the type of contact between a properly square and flat shank and a tappet that has cupped from use with crowned shanks. The contact is closely confined to the rim of the cupped striking face and the corners of the shank striking end. The total area of contact between the two is only a fraction of the amount for which the tappet had been designed, with the result that the intensity of the blow has been greatly increased, and the shank end will develop a crowned end to conform to the tappet, or the rim of the striking face will be chipped, or both.

Chipping of the rim of a cupped tappet face through use with a flat shank is shown in Fig. 5.

Worn chucks are second in importance as a factor in causing striking-face failures. The section of a rather badly worn chuck is shown in Fig. 6. It will be noted that the wear in the hexagon bore is greatest at each end, whereas the wear at the middle is considerably less.

In Fig. 7 is seen the type of contact obtained between a flat-faced piston hammer and a correctly made shank when used in conjunction with a badly worn chuck. The contact between the shank and piston hammer face is limited to a small area on a corner of the shank face. As the hammer and shank rotate together, the contact shifts from one point to the next on the rim of the shank striking end. This confinement of contact will soon develop a depressed ring on the piston hammer striking face, which may also be accompanied by some flaking. Such a face is shown in Fig. 8. In addition, shank striking ends will soon become high centered or crowned, inasmuch as all of the impact is imposed on the rim of the striking end.

Another condition, which in effect is the same as the use of worn chucks, is the use of undersize shanks. Though such use does not bring about the degree of shank misalignment that results from the use of worn chucks, it is a factor which merits consideration.

In Fig. 9 is shown a badly shattered shank striking end. This is an extreme example, yet it illustrates a type of shank condition that is frequently seen. The fact that it has shattered indicates to the most casual observer that it must be very hard. Actual hardness tests made on it disclosed a value in excess of the hardness considered as standard on a piston hammer or tappet face.

Toughness vs. Hardness

It is desired to point out here that to develop the essential amount of toughness in a piston hammer or tappet striking face, the maximum hardness that can be obtained by hardening steel cannot be used. It is for this reason that shanks can be hardened to a degree greater than that considered standard in the hammer or tappet. A properly hardened shank should be definitely softer than a piston hammer to prevent early failure of the latter and the probable failure of the shank by shattering. A section was made of the shank shown in Fig. 9 for a length of about 1½ in. of the striking end. This section was polished and lightly etched in acid to show the structure present. A photograph is shown in Fig. 10. Two types of structure are clearly in evidence in this shank section. The etched portion, distributed over the end and down the sides, has resulted from hardening the shank by water-quenching from a temperature probably higher than recommended. At any rate, the etched zone is definitely too hard—in fact, harder than a standard piston hammer. Recommended practice for hardening shanks on the conventional type of carbon drill steel calls for quenching in oil from a temperature in the range of 1,450 to 1,500 deg. F. Use of higher hardening temperatures will be likely to cause excessive hardening of the extreme corners of the striking end even if quenching is done in oil. Though the extent of the excessively hardened areas would not be as great as if water quenching had been used, the damage to the piston or tappet striking face would be as certain.

Effect of Hard Shanks

In Fig. 11 is shown a tappet which had been operated against excessively hard shanks. The shanks must have been fairly flat, as indicated by the rather minor amount of cupping. The extensive chipping of the face, however, is undoubtedly the result of excessive shank hardness. It is probable that hard particles have chipped from the shank and have been pounded into the shank and striking face. The ragged corners resulting from chipping of the shank further caused nicking and flaking of the striking face.

A shank with a properly flat face that is not at right angles to the axis of the drill steel is shown in Fig. 12. The square placed against the shank shows the off-square condition. The example is extreme, although the condition is fairly common where the proper facilities for squaring shanks are not available or where the necessary attention is not paid to this phase of shank preparation or maintenance.

The type of contact resulting from the use of an off-square shank and a flat piston-hammer striking face is shown in Fig. 13. The contact is well outside of the piston-hammer face.

Inasmuch as the shank and piston hammer rotate together, the high point of the shank will repeatedly contact the same localized area on the piston-hammer face. Chipping of the latter will often occur from the same reason as when using crowned shanks or worn chucks—that is, from the reduction in area of contact and a corresponding increase in intensity of blow per unit of area. Another type of failure is often seen in connection with the use of off-square shanks on piston-hammer faces in particular. This is the familiar clamshell type of failure shown in Fig. 14. This type of failure is sometimes ascribed to a defect in material, the reason being that in the early days of piston-hammer manufacture a defect was actually visible to the naked eye or at most required the use of a pocket magnifier for its detection. In more recent years, however, through cooperation between the steel makers and drill manufacturers, the occurrence of defects in material has been reduced to such an extent that it is seldom that a defect can be found at the center of such a failure, even though examination is made at high magnification. Frequent investigations have led to the finding that the condition illustrated by Fig. 13 often causes the formation of a small crack below the surface of the striking face which was subjected to the blows of high intensity by the high point of the shank. Continued operation causes this small crack to grow outwardly, each ring representing an additional amount of growth which continues until a large piece of the face shells off. The ultimate failure is the same, whether it has its origin in a defect in material or a subsurface crack caused by localized and repeated contact.

In all of this presentation of typical striking face failures, which in practice might exist as presented or as a combination of two or more of the individual types, two broad conditions are necessary for premature failure. One is a condition which reduces area of contact between the striking face and shank, and such a reduction will result from the use of crowned shanks on a square face; square shanks on a crowned face; worn chucks permitting misalignment of shanks; off-square shanks on a square face; or a shattered shank on a flat face. In any case or a combination of cases, the reduction in contact area means a corresponding

increase in the intensity of blow transmitted by these areas. Inasmuch as all material has a limit beyond which it will fail, it is evident that by sufficient confinement of contact area the intensity of imposed stress will exceed the strength of the material, and failure by breakage will occur. If intensity of the blow due to confinement of area of contact is just below the strength of the material, breakage may not take place, but premature wear will certainly develop. The obvious practice to establish then would be:

1. Square up and flatten by careful grinding all of the piston-hammer or tappet-striking faces. Remove no more than $\frac{1}{16}$ in. of the face as originally available, inasmuch as the depth is only about $\frac{1}{2}$ in.

2. Square up and flatten by careful grinding, hot-milling, or forging in a shanking cap, the striking end of all shanks. This is an operation which should be periodically carried out, inasmuch as all shanks in service become more and more crowned.

3. Replace worn chucks to help maintain alignment. When the wear is too great, the damage from additional use of the chucks more than offsets the savings in chuck cost.

4. Little has been said about actual operation of the drill as a factor, but it is certain, particularly in drifting work, that much can be done by the operator to maintain machine alignment and thus improve the character of the contact between the shank and piston hammer or tappet.

The other general condition that brings about premature failure of the striking face failure is the use of excessively hard shanks. It is conceivable that a shank of the same hardness as a piston hammer would perform satisfactorily if the striking end is kept flat and the shank kept in perfect alignment, as is the case with a tappet operating against a piston hammer. However, this is impossible, as misalignment will develop as soon as the chuck parts begin to wear, with the result that contact area becomes less. Inasmuch as perfect contact between the shank and hammer cannot be maintained at all times, it follows that the shank should be somewhat softer than the piston hammer or tappet to prevent early damage to striking faces. For this reason heat-treatment of shanks is strongly recommended so that excessive hardness will not be obtained. With carbon drill steel, hardening from a temperature in the range of 1,450 to 1,500 deg. F. by quenching in oil is considered standard practice.

The best insurance against unduly hard shanks is the testing of every shank following the hardening operation. The simplest and most effective method is to use a file on the corners of the striking end of the shank. A sharp file will readily "take hold" of a shank that is not too hard. On the other hand, if a shank is as hard as, or harder than, a hammer, the file will rasp over the surface with little or no cutting effect. The use of a file in the hands of a fairly competent inspector is an invaluable means for detecting excessively hard shanks. Hardness testing machines may also be used, but their disadvantage lies in the longer time required for testing; the small area represented by one test or several tests; the difficulty of obtaining tests on corners where excessive hardness most often occurs; and, finally, the greater care and experience required to obtain truly representative hardness values. In any event, an efficient system of hardness testing will go far toward the establishment of correct shank-hardening practice and resultant increase in the life of striking faces.

No general recommendations for the heat-treatment of some of the new alloy drill steels can be presented, owing to the variety of such steels available. Some alloy steels cannot be hardened by any of the usual methods to develop a hardness that will even approach that of a standard hammer or tappet. Others, however, can develop a hardness definitely higher than that of a standard hammer or tappet simply by allowing them to cool in air from a recommended hardening temperature. If alloy steels are used, the recommendations of the respective manufacturers should be closely followed and an effective system of hardness testing employed.

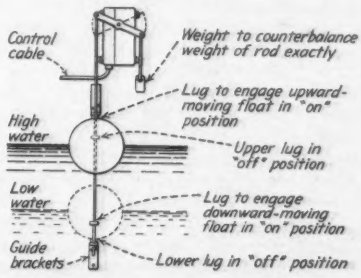
To sum up, the life of the striking face of piston hammers or tappets can be greatly increased by utilizing a maximum area of contact between the striking face and shank and by using only shanks that display a hardness definitely less than that of the piston hammer or tappet.

▼ ▼ ▼

A Simple Scheme for Controlling Pumps Automatically

WHERE pumping is controlled automatically, the simple, inexpensive control arrangement described here by R. L. Loofbourow, superintendent of the Reliance mine, Manhattan, Nev., may be useful. For more than a year all the mine water (about 100 g.p.m.) has been handled by two centrifugal pumps. One, powered by a 7½-hp. motor, pumps from the 465 to the 365 level. The other, driven by a 20-hp. motor, pumps from the 365 level to surface. The units have proved satisfactory, and under normal conditions their capacity is about 50 per cent above requirements. Operation is intermittent and is controlled automatically by float switches which actuate with 110-volt current automatic starters protected by low voltage releases and thermal overload relays. The original float switches were operated by chains running over pulleys. These became fouled with mud at times, and the net pull effected by a moderate-size float on one end of the chain and a counterweight on the other was not always enough to throw the switches. Separate float switches were installed to sound alarms if water rose too high, but these also fouled occasionally and proved no protection when the operating switches refused to turn off, allowing the pumps to run dry.

To remedy this, several men suggested changing the float switch mechanism to correspond with a design used by Treadwell Yukon Company, Ltd., at Tybo, Nev. Chains, counterweights, and pulleys were removed and the original floats placed so as to slide on rods, as in the sketch, giving a positive push or pull on adjustable lugs mounted on the rods, which, in turn, actuate the switch arms. Several brackets spaced according to the length of the rods serve as guides, with two of them placed so as to halt any motion of the rods beyond the "on" and "off" positions of the switch arms to prevent strain on the switches at times of abnormal water level. A small counterweight balances the weight of the rod and lugs so that, once on, the switch remains on until the float, sinking as the water level drops, pulls the rod down, thus turning the switch off.


Control cable
Weight to counterbalance weight of rod exactly
Lug to engage upward-moving float in "on" position
High water
Upper lug in "off" position
Low water
Lug to engage downward-moving float in "on" position
Guide brackets
Lower lug in "off" position

Parts used in the layout include 9-in. spherical copper floats, with a ⅜-in. tube through the center to permit passage of the rod (weighted so as to submerge about half); rods made from ¼-in. bronze welding rods; Square D Class 9035 Type C4, 110- or 220-volt, 1-hp. operating switch; Square D Class 9036 Type C4, 110- or 220-volt, 1 hp., alarm switch (is much lighter than operating switch, but may be substituted); and a Cutler Hammer, Bulletin 9586 a.c. Auto starter Type AA across-the-line, with thermal overload relay.

Designing a Steel Headframe for a Small Mine

Arc welding played an important part in the construction

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WHILE it may sound absurd to speak of erecting a steel headframe over a shaft 150 ft. deep, that will not be sunk any deeper, has only one level, a hoisting duty of 50 tons a day, and an anticipated life of two to three years, in the particular case described it appeared to be good practice.

The property is a drift gravel mine in Butte County, Calif. The channel was bottomed at 150 ft., and a drift driven across it, which will be the only level. When the property was taken over there was an A-type headframe in poor condition. This was patched up and made to answer during unwatering and sampling, but was not considered safe for a cage and car in regular operation. As a consequence, I designed a conventional A-type headframe 30 ft. high to be built of 8x8-in. timbers. However, before work started on it a machinery dealer, who had on hand a large amount of structural steel he had bought cheaply, offered to supply the material at a price that made a steel headframe worth considering. So a headframe was designed as in Fig. 1. It was estimated that the hoisting load would be: Cage, 1,000 lb.; car, 500 lb.; gravel, 1,000 lb.; rope, 115 lb.; or a total of 2,615 lb. Allowing 10 percent for starting inertia and acceleration, the total load on the rope would be about 2,900 lb., or 1.45 tons. Standard cast-steel rope, 6 strand 19 wire, $\frac{5}{8}$-in. diameter, has a breaking strength of 13.1 tons, giving a factor of safety of 9. Mine safety orders of California require a minimum factor of safety of 8, so the $\frac{5}{8}$-in. rope was chosen.

The diagram gives the essential features. All members were 6x4-in. I-beams, except the braces, sheave posts, and guide-post supports. Thus, in framing, the ends of the girders fitted into the channels of the posts. Sheave posts were 6-in. channels, $\frac{1}{2}$-in. thick, with 2-in. flanges fitted over the ends of the sheave beams. All bracing was of 4x3-in. I-beams, and guide-post braces were of $\frac{1}{2}$-in. steel, 3 and 4 in. wide. As an extra precaution, angle braces 4 in. wide, $\frac{1}{2}$ in. thick, each leg being 6 in. long, were set over each end of the upper girder and over the upper end of each sheave post. All joints were arc-welded. Stress diagrams and calculations are not produced here, but in all cases the factor of safety was liberal. For example, the stress on each back leg worked out 16,700 lb., and the safe working load for the span chosen is 81,800 lb. The stress on each sheave beam is 4,250 lb., and the safe working load as a cantilever loaded at the end is 6,650 lb. The plan was to set the concrete piers and bolt the foot plates to them. Then all members of the hoisting panel would be framed on the ground, the whole raised, properly centered, and the posts welded to the foot plates. This part of the structure would be securely anchored to deadmen while the back legs were put in place. Following are the specifications for the material required:

6x4-in. I-beams—Two posts 30 ft. long; 2 back legs 30 ft. 3 in. long; 1 top girder 3 ft. 7 in. long; 1 bottom girder 4 ft. 3 in. long; 2 girder posts 3 ft. long; and 2 sheave beams 2 ft. long.

4x3-in. I-beams—Front bracing 39 ft. 5 in.; back bracing 47 ft. 5 in.; and side bracing 15 ft. 6 in.

6x2-in. Channels—Two sheave posts 4 ft. long.

Guide Supports—Two 3x$\frac{1}{2}$ in., 7 ft. long, and two 4x$\frac{1}{2}$ in., 7 ft. long.

Angle Braces—Four 4x$\frac{1}{2}$ in., 1 ft. long.

Foot Plates—Four 8x8 in., $\frac{1}{2}$ in. thick.

Making allowance for even lengths

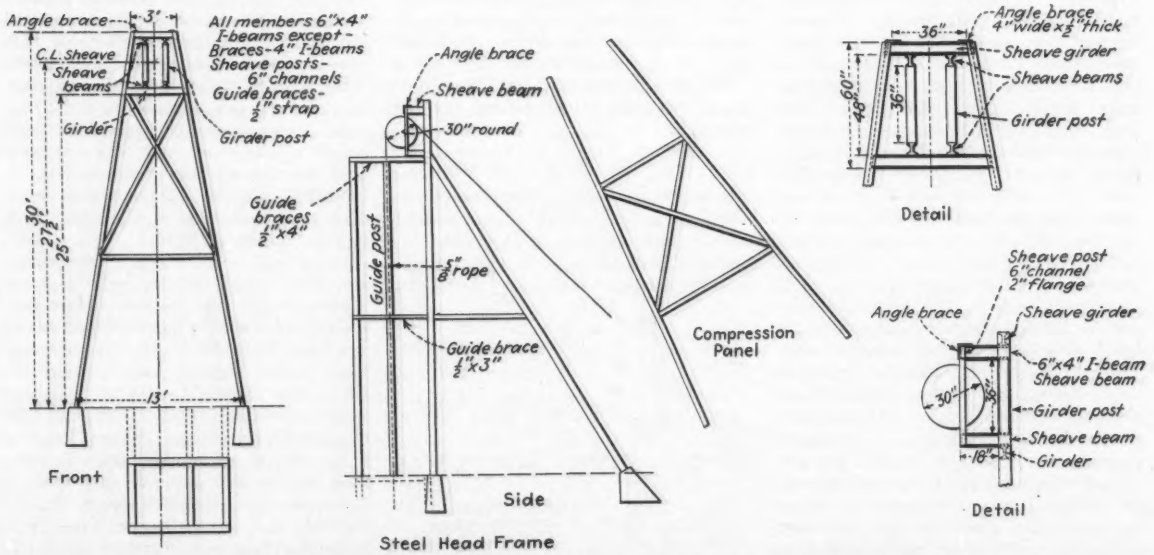
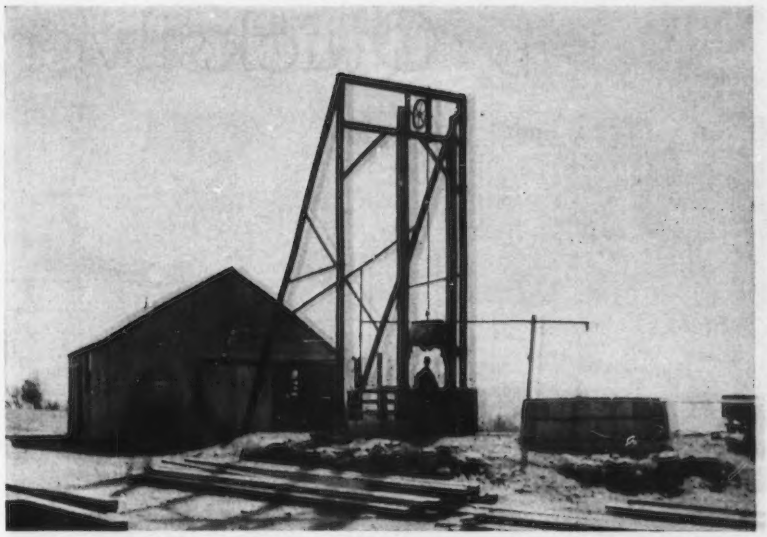


Fig. 1 . . . Front and side elevations of the steel headframe as designed, with details



The steel headframe as finally erected

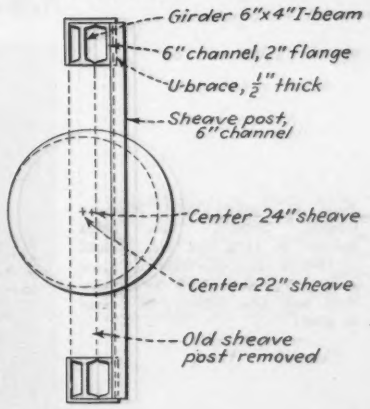
in which it would be necessary to buy the preceding material, the total weight would be 4,395 lb. The quotation was 2½¢. per pound, so that the cost of steel figured $110. Freight was 50¢. per 100 lb., making the cost delivered $132. Cost of lumber and hardware for the wooden headframe was estimated at $170, including freight. The post and back legs would be cut at the yard because, on account of the batter, it was desirable that their ends be true, but the remaining members would be cut on the ground with a torch, as any slight irregularities at the joints could be smoothed off or filled in while welding. Cost of cutting posts and back legs to true dimensions was $10. Three days' time was estimated for erection with a crew consisting of a welder, truck with crane and driver, foreman, and two helpers. The welder furnished his own portable outfit and material for $20 per day. Wages on this basis were estimated at $159. The four concrete piers were estimated at $20. Because of filled ground around the shaft these were carried deeper than ordinarily would be necessary. The total was $321, which with the allowance of 10 percent made $350 as the final cost. Subsequent construction of a similar headframe showed the preceding to be a close estimate. The wooden headframe had been estimated at $400. As to painting, it was found that there was little difference in surface area, although that of the wooden headframe was slightly larger. The steel headframe has the advantage that a single coat with a spray gun will answer the purpose, whereas the wooden headframe should have at least two coats. That is the way it was planned, but before the design was finished I left the job for some time. The management was anxious to get the property into production, and the machinery dealer assured them that he knew all about headframes, so was told to go ahead and install one.

When I returned to the job I found that the headframe erected in my absence differed in many respects from the unit I had planned. There was no batter to the main members, and the posts were set alongside the shaft instead of back of it, thus limiting the sheave diameter to 22 in., as one of greater size would have thrown the hoisting rope off center. Sheave posts were directly between the girders, and the sheave shaft was rigidly connected to them on the center line with insufficient space for fleeting of the rope. The sheave turned on the shaft on a bronze bushing. As considerable time had been lost, it was desirable to use the headframe in place if possible. An inspection disclosed that it could be utilized after some bracing and redesigning of the sheave posts so that the sheave would be supported by the usual type of shaft bearing. The latter was accomplished as shown in Fig. 2. The old sheave posts were removed and four pieces of 6-in. channel, 6 in. long and with 2-in. flange, were welded in pairs 15 in. apart to the upper and lower. The edges of the channels were welded to the edges of the I-beams, so that each piece was secured by 24 in. of weld. Then each vertical pair of these pieces was connected by a 6-in. channel 4 ft. long, the flat portion toward the shaft. These uprights formed the sheave posts to which the sheave blocks were bolted. As reinforcement, a U-shaped piece of ½-in. steel, 4 in. wide, was placed at each end of the sheave posts, so as to fit inside the channel and around the girder. By this arrangement the face of the sheave post was set 4 in. back from the center line of the sheave as originally installed. As it was 3 in. from the base to the center of the sheave block, this gave 1 in. more radius, and allowed an increase in the groove diameter of the sheave from 22 to 24 in. It had been planned originally to use a 30-in. sheave, but the 24-in. unit is within State requirements.

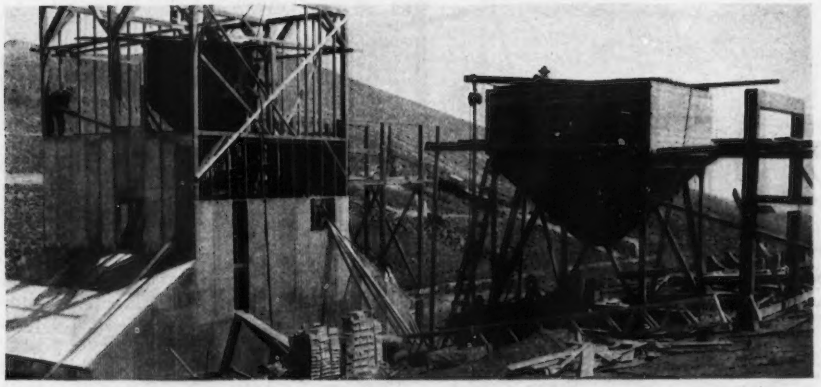
There was another plan in this connection that was never carried out. The installation included a hoist, and it was my idea when the concrete for the base was set to imbed I-beams in this pattern. These would be leveled and set with just the flange projecting above the concrete. The hoist would be set on the I-beams, lined up, and welded to them at ends and sides. Instead of six bolts imbedded in the base to hold the hoist there would be eight welds, those at the ends being built up heavily to resist the sliding and lifting tendency of the hoisting. However, the hoist had been installed in the meantime in the usual manner with the frame bolted to bolts imbedded in sulphur in holes in the concrete bed.

It will be noted that arc welding played an important part in the planned construction, and in that actually carried out. The outfit used was a self-contained unit mounted on a truck, so as to be moved easily wherever needed. Welding covers a multitude of sins, as members to be welded need not be cut to exact dimensions, with holes carefully drilled to exact dimensions and closely registered. With welding any slight irregularities can be taken up with the weld. Arc welding thus has simplified construction of this kind, and has shown a material saving of time over drilling or riveting, or even boring and bolting timbers. A steel structure has the advantage that there is no deterioration if it is kept painted, and when the mine is worked out the headframe is easily dismantled by burning out the welds with practically 100 percent salvage.

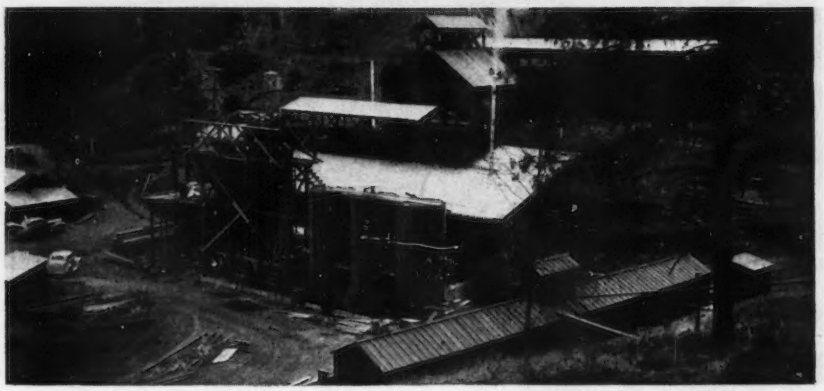
Fig. 2 . . . Illustrating the method adopted for realigning the sheave posts



Quicksilver



Erection of 40-ton Herreshoff plant (by Pacific Foundry Co., San Francisco) at McAdoo mine, Bottle Creek district, Nevada. Plant of Scossa mine on distant hill



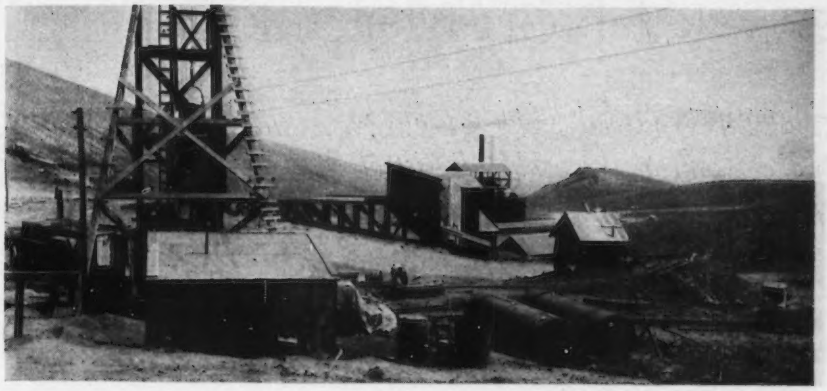
Construction of second Gould plant (the third furnace) at the Bonanza mine, Douglas County, Oregon. This brings total plant capacity to 200 tons and maintains Bonanza's position as America's leading quicksilver mine

Koehring "Dumptor" truck (powered with General Motors diesel), one of the new items of equipment enabling the Sulphur Bank mine (Lake County, California) to break its previous waste stripping records

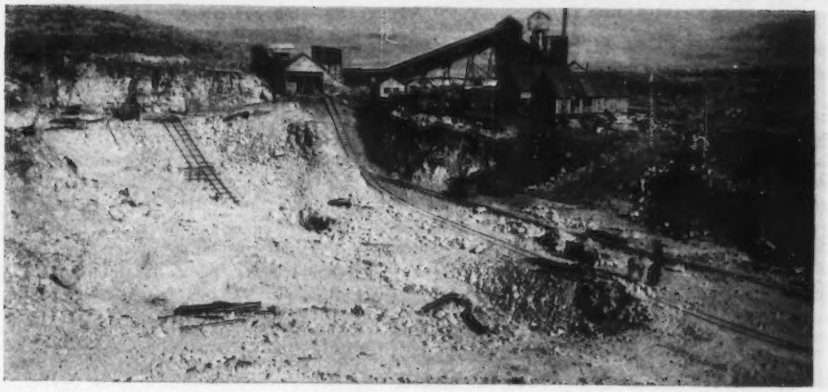
Plant of Opalite mine, Malheur County, Oregon. This plant burned in 1938 and was rebuilt in 1940 to treat ore from the Bretz mine (10 miles away by truck). Note new dust collector at center of plant

PHOTOGRAPHS OF SOME CURRENT OPERATIONS IN FOUR

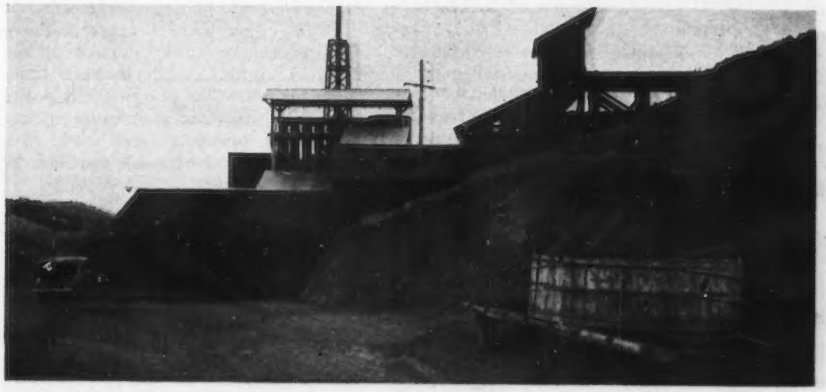
Mining Thrives



From left to right, in Bottle Creek district, Humboldt County, Nevada. Plant of Scossa mine (in distance); headframe and shaft of McAdoo mine; plant (Gould rotary) of Greenan's Blue Can mine. Feature of this district is close spacing of plants



Plant and open cut of Idaho Almaden mine, near Weiser, Washington County, Idaho. This is a comparatively recent development in a new district; operations started in May, 1939



Rotary plant of Knoxville mine, Napa County, California. This plant is operating on dump material and there is a trommel but no crusher, in the building. Meanwhile underground development is proceeding at the property

Underhanding in glory hole at Bretz mine, Malheur County, Oregon. This small, high-grade orebody was discovered by the Bretz brothers in 1939 after the original orebody, further to the east, had been mined out in 1936.

WESTERN STATES CONTRIBUTED BY WORTHEN BRADLEY

PHOSPHATE

The Vital Non-Metallic

V—The Tennessee field presents a picture markedly different in most respects from that of the pebble district of Florida—Here also the International Agricultural Corporation conducts mining operations and has two washing and recovery plants

A. H. Hubbell
Associate Editor

► MINING AND WASHING OPERATIONS *in the pebble phosphate field of Florida have been dealt with in the four preceding installments of this article. Part I, published in the September, 1940, issue, presented a general picture of the situation in the industry and described the Florida operations of the International Agricultural Corporation. Parts II to IV inclusive dealt successively with the mines and plants of the other operators of the pebble area. In the current issue attention is directed to the region of south-central Tennessee, which, with Florida, accounts for 95 percent of the United States' output of phosphate rock.*

AFTER finishing my tour of the pebble phosphate field of Florida, as described in preceding articles,[15] I transferred my attention as well as my person to the present phosphate-producing area of South-Central Tennessee, leaving the hard-rock field of Florida for a more propitious day, when recovery in the export business or other event now unforeseen might permit at least some of the companies of its present inactive industry to resume their operations.

A brief stop at Muscle Shoals en route gave me a glimpse of the Tennessee Valley Authority's electric-furnace operations with phosphate rock from both Florida and Tennessee as raw material. I will not attempt to deal with this activity, if only because of space limitations and the fact that electrothermic production of elemental phosphorus and its compounds at this Government plant has already been described exhaustively in many papers by T.V.A. officials as well as in their testimony before the Joint Congressional Committee, all of which information is available to the public. Suffice it to say that the Government's plant at Muscle Shoals is the one electric-furnace plant in the country that visitors—or shall we say editors—are permitted to see, and even there a veil is drawn over the research projects under way.

As pointed out in an earlier article,[16] the ability to treat exceedingly low-grade phosphatic material in the electric furnace, as well as the development of the flotation process, has had a profound effect on the estimation of reserves of phosphate. G. R. Mansfield[17] of the U. S. Geological Survey, who now places Florida's reserves at 5,000,000,000 tons of material containing 40 percent or more of B.P.L. (approximately 18 percent P_2O_5), two-fifths of which he classes as 70 percent material or higher, a fourfold increase, credits Tennessee with 100,000,000 tons of brown rock, a fivefold increase in the tonnage of the particular type of phosphate rock that is being exploited in Tennessee today. Tennessee also has its blue and its white rock, which its State Division of Geology, at Nashville, considers of commercial importance, although they are not now being worked. It is with the brown rock, however, that we are in this description concerned.

George I. Whitlatch, associate geologist of the Division of Geology, has prepared[18] a "limited" estimate of brown-rock reserves, in which he puts the total at 96,918,300 long tons (dry basis[19]), containing a minimum of 35,000,000 long tons of B.P.L., or, in other words, approximately 34½ percent rock. These reserves, he states, are greater today than at any time in the history of the industry. Almost 43,000,000 tons of this amount is in Maury County, where the Mt. Pleasant field is situated, the bulk of the remainder being in Giles, Williamson, and Hickman counties near by. Mining is conducted chiefly in Maury and Giles counties. A map of this region is reproduced in Fig. 11.

To cite Whitlatch further, the brown phosphate "is a residual product derived from the solution of calcium carbonate from phosphatic limestone[20]; it forms either blanket deposits above the limestone or 'cutter' deposits in the widened solution joints between limestone masses. The phosphate deposits normally consist of a mixture of coherent thin plates or 'plate rock' in a matrix composed of small particles or 'sands' and varying proportions of clay, silica grains, and other impurities that are collectively called 'muck.'" There is also the so-called "rim" or "hatband" deposit, formed where a flat-lying blanket deposit is exposed on the sides of a hill.

Conditions in the Mt. Pleasant field vary greatly as to depth of overburden and depth of matrix and their relation to each other. The variation is perhaps too great to permit a generalization. One informant cited places where there was as much as 20 ft. of overburden and 25 ft. of matrix. Another mentioned one having only 8 ft. of overburden and 3 ft. of matrix. Common practice, it was said, was not to mine where the ratio of overburden to matrix exceeded three to one.

Attention was first directed to phosphate rock in Tennessee in the early nineties, when the presence of the blue rock was noted, the brown rock being discovered three years later, thereafter remaining the basis of the mining in-

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[15] *E.&J.*, Sept., Oct., Nov. and Dec., 1940.

[16] *E.&J.*, Sept., 1940.

[17] T. P. 1208, A.I.M.E.

[18] In a paper entitled "Phosphate Reserves of Tennessee," presented at the Tuscaloosa Meeting of the A.I.M.E. in Nov., 1939.

[19] Brown phosphate in the ground (dry basis) weighs about 80 lb. per cubic foot according to Whitlatch.

[20] The parent phosphatic limestones are considered a potential future source of phosphate. According to W. F. Pond, State Geologist of Tennessee, there is a large tonnage running 15 to 45 percent B.P.L.

Stretch of mined-out ground after being worked by International Agricultural Corporation close to Mt. Pleasant. Here there was 14 to 18 ft. of overburden. In the distance is one of the I.A.C.'s draglines with a 1¼-cu.yd. bucket and a 50-ft. boom. See page 52

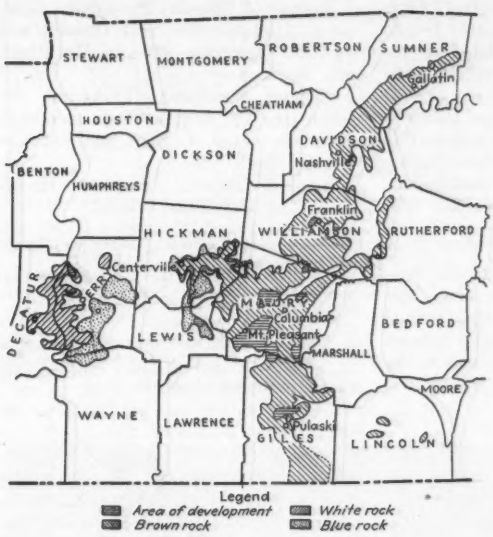
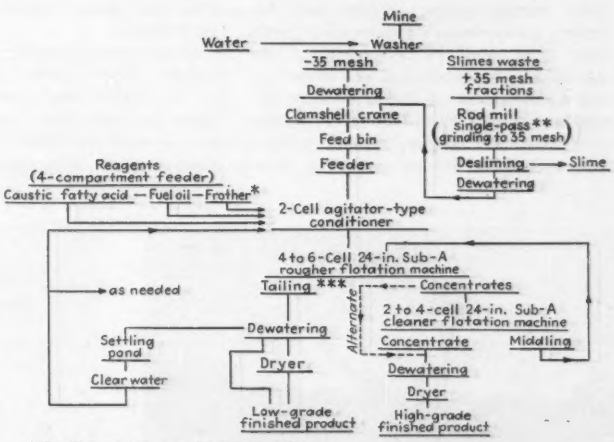


Fig. 11 . . . The phosphate rock regions of central Tennessee. The present productive part centers around Columbia and Mt. Pleasant. Map prepared by Tennessee Division of Geology

Fig. 12 . . . Generalized flowsheet of phosphate flotation practice in the Tennessee field, where there are four flotation plants today. Drawing after a sketch furnished by James A. Barr, of International Arcicultural Corporation



* Frother used in some instances only.
** Single-pass grinding because of presence of hard "flint" (SiO_2) particles which will build up in closed circuit.
*** Clarified return water from tailing pond can be used to advantage in closed circuit

dustry that grew up. The crudities of early mining in the State have been discussed by several writers, notably James A. Barr. For some years the plate rock only was sought, being mined by hand and separated from the matrix by forks, the rest being thrown away. At this time the domestic trade demanded a rock guaranteed to be at least 75 percent B.P.L. Plate becoming scarcer, washing practices were developed to utilize the finer material, thereby bringing new tonnage into the category of reserves. In turn the amount of commercial washable matrix dwindled and once again the Tennessee industry's lease on life was extended by the introduction of flotation into that field in 1932 and a few years later by the application of nodulizing and sintering as a means of preparing siliceous matrix of poorer grade for reduction in the electric furnace. Today, washing practice in the field is developing toward a larger scale of operation, with the changes meanwhile that are necessary to this end. Though conditions differ from those in Florida's pebble field, the competition of cheap rock from the latter must be met.

According to James A. Barr, of the International Agricultural Corporation, in a specially written note, flotation is used in Tennessee in two general ways.

First: To take a washed product from a regular phosphate washer that is of medium grade in respect to B.P.L. and split it by flotation into (1) a high-grade concentrate, say 75 percent B.P.L. suitable for such outlets as fertilizer trade; and (2) a low-grade tailing of the B.P.L. desired for such outlets as furnace trade where the higher SiO_2 is welcome or several other trade outlets. Such use is becoming of increasing importance since deposits which yield a high-grade rock with washing only are being depleted.

Second: To take a strictly low-grade washed product and float it up to (1) a high-grade (72-75 percent) B.P.L. concentrate for fertilizer trade; and (2) a sub-grade, high-insoluble tailing which can be used with furnace-grade matrix or washed matrix, where this is too high in lime (CaO).

The latter practice has resulted in an increase in the estimate of Tennes-

see phosphate reserves by permitting exploration of deposits formerly classed as non-commercial as well as reclamation of tailings from earlier washers.

There are four phosphate flotation plants in Tennessee, all operating under patent and license from the Phosphate Recovery Corporation, 61 Broadway, New York. These plants have an aggregate capacity of 2,000 tons of feed per (24-hr.) day.

In general (see Fig. 12) the flotation flowsheet takes a −35 mesh deslimed washer product, conditioned with suitable reagents in a thick pulp, then diluted to approximately 20 percent solids and floated in mechanical sub-aeration machines, though in one instance a pneumatic cell of the Forrester type is used.

Cleaning cells may follow roughers if required by the initial grade of the feed and the grade of the concentrate required. Middlings are usually returned to the head of the roughers.

Some plants treat only the deslimed −35 mesh washer fraction; others grind one or more of the coarser deslimed washer products to 35 mesh and again deslime and dewater, and then float as noted in the foregoing.

As this evolution in treatment has been taking place, mining too has grown away from crude earlier methods. The mode of occurrence of the phosphate, however, has not permitted the development of the large-scale operation seen in Florida. In Tennessee the phosphate matrix, with or without its plate rock, lies on unaltered phosphatic limestone, instead of on soft deposits as in Florida, and the upper surface of this limestone may be most uneven and carved by solution in irregular cutters and jagged pinnacles, in and around which the loose phosphatic material rests. The dragline has made its entry for both stripping and mining (hydraulic methods are not used) and is to be found in all types of drives and mountings, but it is a much smaller excavator than the huge electric machines seen in Florida, which in many cases represent an investment of something like $175,000 for the machine alone. And even today laborious hand labor is often necessary to recover the phosphate from the limestone cutters in conjunction with the dragline.

Railroad transport for the most part, with cars of modest capacity, is relied upon for carrying the matrix from mine to washer, although motor trucks are now being used to some extent. Under such conditions and with a much smaller output operating costs can be expected to be higher. One thing is cheaper and that is electric power, this area being part of the Tennessee Valley region. The trend toward modernization continues and the future will doubtless bring important new improvements.

There are no public lands in Tennessee. There never have been any U. S. lands, and such State-owned lands as there were originally passed into private ownership long before the discovery of phosphate.[21] Today the bulk of the brown ore reserves of Maury County, the heart of the phosphate-producing area, is held by the operating companies.[22] The farmer for the most part owns the rest.

Present production of phosphate rock in Tennessee, amounting to approximately one-fifth of this country's annual output, comes from six companies, whose average monthly payroll in 1938 was estimated at about $230,000 by one of the witnesses at the Congressional investigation. These companies are:

The International Agricultural Corp., which produces phosphate also in Florida.[23] Its local headquarters are at Columbia, Tenn.

Charleston Mining Company, of Richmond, Va., owned by the Virginia-Carolina Chemical Corporation. Its office is at Mt. Pleasant, Tenn.

Hoover & Mason Phosphate Company. Its head office is in Chicago and its local operating office in Mt. Pleasant, Tenn.

Armour Fertilizer Works, at Atlanta, Ga. Its office in Tennessee is at its plant about 7 miles west of Columbia, Tenn.

Federal Chemical Company. Its office is in Columbia, Tenn.[24]

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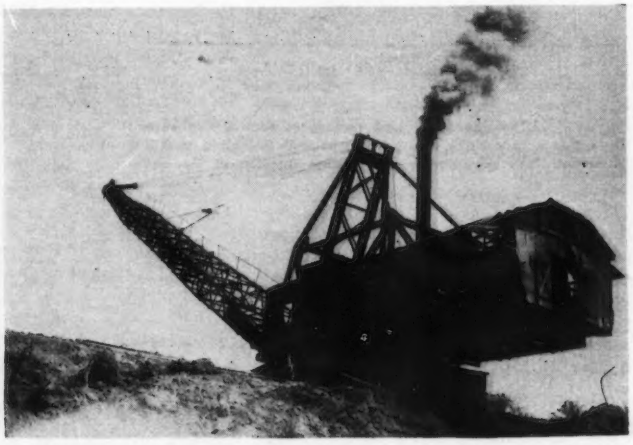
[21] George I. Whitlatch, Paper at Tuscaloosa Meeting, A.I.M.E., Nov., 1939.

[22] Walter F. Pond, State Geologist of Tennessee. Testimony before the Joint Congressional Committee.

[23] *E.&M.J.*, Sept. 1940.

[24] Unfortunately we received no replies to our requests for permission to visit the operations of this company and so are unable to discuss them here.



Above left, On I.A.C.'s Sumpter tract at Wales, Tenn., almost worked out at time of visit. The bigger dragline is stripping, with the overburden increasing as the machine advances into the hill. The smaller one is working a bank of fine phosphate sand. Above right, a close-up of the dragline engaged in stripping on the Sumpter tract. At left, wet storage of washed phosphate rock at I.A.C.'s plant at Wales, Tenn.

Monsanto Chemical Company, of St. Louis, Mo. Its mine and plant and office are at Monsanto, Tenn., 5 miles from Columbia.

International Agricultural Corporation's Operations in Tennessee

Arriving in Columbia, Tenn., after leaving Muscle Shoals, Alabama, 60 miles southwest by rail, I selected it as a convenient stopping point from which to see the phosphate mines, washers, and other treatment plants of the district. Transportation is readily available. Mt. Pleasant, indeed a pleasant town aside from lacking adequate hotel accommodations, is 10 miles away and is easily reached by bus or taxi. From these two communities all of the active phosphate operations can be visited readily, with the possible exception of Wales, in Giles County, 30 miles to the south, where one of the units of the International Agricultural Corporation is situated. Here, however, fortune was kind, and on the next morning after arrival, having made arrangements at the I.A.C. office in Columbia the night before, I found myself on the road to Wales with A. E. Claggett, assistant manager of I.A.C.'s district operations.

This part of Tennessee is a beautiful rolling green farming country, known for breeding "walking" horses as well as for mining phosphate. Incidentally, Columbia is not only "the dimple of the universe," as some motor-car plates proclaim, but it is quite a mule center, the scene of a periodic auction of these animals, and every spring stages a great celebration on so-called "Mule Day." As one may surmise, in such a country it is as important as it is in Florida to keep slimes out of streams and to build ponds and to maintain good relations with one's neighbors. In further comparison with Florida, the problem of water supply here, though not the biggest, is one that requires attention. The supply is insufficient at times and the water has to be conserved. All this

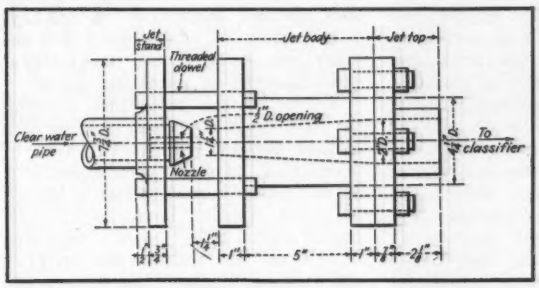


Fig. 14 . . . Sketch illustrating construction of jet shown in Figs. 13 and 15 as serving for transporting sands in washing plants at Wales and Mt. Pleasant

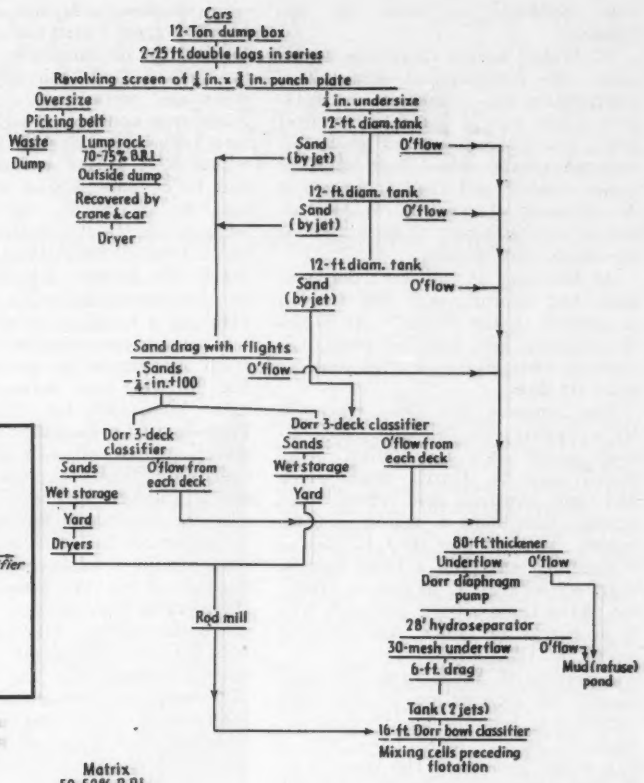


Fig. 13 . . . Flowsheet of washing plant of International Agricultural Corporation at Wales, Tenn.

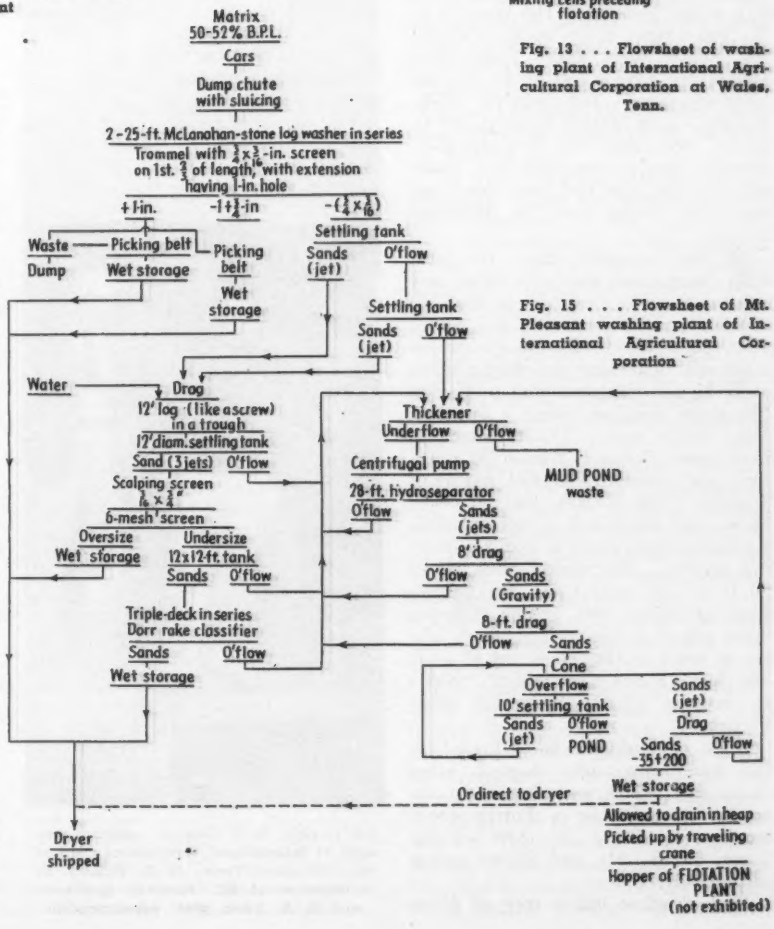


Fig. 15 . . . Flowsheet of Mt. Pleasant washing plant of International Agricultural Corporation

was explained en route by Mr. Claggett.

At Wales, besides its mining operations, the International Agricultural Corporation has a washing and flotation plant and a dryer, a fertilizer plant, and a phosphoric acid and triple superphosphate plant. It likewise mines, washes, and dries phosphate at Mt. Pleasant. In addition to these activities it grinds part of its output as customers may request.

At the time of this visit the company had approximately 300 men on its payroll in the district. At Wales the washing and flotation plant was running seven days per week and the mine six days.

The company has three tracts in Giles County: the Sumpter, now almost mined out; the Pullen, being mined; and the Harris tract, which had been stripped and where some mining was done a month or two before. The Sumpter tract is close to Wales and was paid a brief visit in company with S. A. Britton, a graduate of the University of Alabama, who is in charge of mining and washing under Mr. Claggett.

According to Mr. Britton, the usual manner of prospecting in this area (which was followed on the Sumpter tract) is to put down holes with a 4-in. auger and pipe. The auger is of the Iwan type, made by Iwan Brothers, South Bend, Ind. These hand augers are good to 30 or 40 ft. The holes are usually put down on 100-ft. squares, or, on blanket deposits, 200 ft. apart. Two men will bore 2½ 20-ft. holes in a day, or one 40-ft. hole. Some core drilling also had been done and was then being done in Hickman County.

At the Sumpter tract, the part where operations were still under way was on the side of a hill, so that the overburden was deepening and varied from 30 to 60 ft. as the excavation advanced. Attacking this deep portion at a higher elevation was a Marion 261 steam dragline, using a 3½-cu.yd. Page bucket and a 115-ft. boom. A little lower down, a Marion 36 dragline, also steam-driven and having a 1-cu.yd. Page bucket and a 50-ft. boom, had uncovered a bed of phosphatic material which it would be mining shortly. The matrix runs about 20 to 25 per cent P_2O_5. No definite plan of attack was visible, the pit being almost finished. They were taking as much as they could get of what was left. Slides were giving trouble on account of the deepening overburden.

Rock, or muck, was being loaded by the small drag into 4-cu.yd. side-dump cars, which were hauled to the washer in trains by a Porter steam locomotive. There are three of the latter, of 18-, 21-, and 23-ton rating respectively.

Each dragline had a crew of three —an operator, a fireman, and a combination ground man and oiler. When loading, the machines work two shifts, six days a week. On stripping they sometimes work three shifts. The track crew consists of eight to twelve men, depending on the weather (in winter the larger number). Crews had to be manipulated to give each man 40 hr. weekly, the work done being under the Walsh-Healey Act. It was difficult to avoid overtime, according to Mr. Britton, because one could not foresee all things in advance in planning a dragline's work.

Washing operations at the Wales plant are shown in the flowsheet in Fig. 13. This plant makes three products: lump rock, the sands from the three-deck Dorr classifier (−¼-in.+100 mesh), and the product of the thickener drag, which is −30 mesh and finer. The last was sent to flotation (see the generalized flowsheet in Fig. 12). One of the jets shown in the flowsheet as transporting sand is sketched in Fig. 14. These jets require considerable high-pressure water. The plant also has an Allis-Chalmers rod mill for grinding before flotation, if desired. Occasionally the bowl classifier product has been ground.

Drying of wet storage materials at Wales is done in two 66 in. by 40 ft. hand-fired Schofield dryers. Air is supplied to each under its grate at about ¾ in. of water. In addition draft is supplied by a 125-ft. stack. The current is parallel to the feed.

The materials are dried to 1 percent moisture and elevated to loading bins. Where the feed contains 15 percent water, a dryer will dry approximately 14 tons per hour. With maximum water (25 percent) it will dry approximately 10 tons per hour.

Left to right, A. E. Claggett, assistant manager of International Agricultural Corporation, Columbia, Tenn.; H. O. Pickard, superintendent of Mt. Pleasant operations; and C. A. Irwin, plant superintendent

For grinding dried materials where specified by customers there are two Raymond mills and air separators and one Kent mill, which is used mostly for fertilizer fineness (60 percent minus 200). The Raymond mill delivers to a cyclone, which discharges to a bin, from which bags are filled direct by a Bates packer.

At Mt. Pleasant, the company is operating a washing and flotation plant that locally is known as the Blue Grass No. 3, its name under a former owner. Officially it is the Mt. Pleasant washer. During five days of each week, this was running on mine rock on two shifts and on settling-pond sands on the third. On the other two days it ran on settling-pond material or purchased muck.

Nearby is the tract that supplies the rock (page 49). Here, mining of a blanket deposit, with 14 to 18 ft. of overburden, has long been under way. In the distance could be seen a Marion 36 steam dragline, having a 1¼-cu.yd. bucket and a 50-ft. boom. Beginning at one side, the dragline had stripped and then mined successive cuts, piling the overburden in the adjacent mined-out cut and loading the matrix into 2-cu.yd. end-dump cars, which were hauled, in trains by steam locomotives, to the plant. Here the cars were pulled one at a time up an incline to the dump chute by a small hoist. When a car is in the dumping position, the matrix is sluiced into the chute with a water nozzle under 125-lb. pressure. Similar sluicing is done at the lower end of the chute, the matrix being washed into a 25-ft. McLanahan-Stone log washer directly below. The water thus used in sluicing is part of the supply for subsequent washing. The log is kept so that it just overflows through a side discharge with a 1-in. grating. The approximate flowsheet of the Mt. Pleasant washing plant is given in Fig. 15. For the flotation section the reader is referred to the generalized flowsheet in Fig. 12.

All products except the Dorr rake sands go to the wet storage yard. This is served by an overhead crane having a 2¼-cu.yd. grab which delivers to the drying plant hopper. Drying is done in two 5x40-ft. stoker-coal-fired counterflow Schofield dryers, making 11 r.p.m. The dried product is elevated and delivered in a motor-driven dump car to a dry storage shed, 50x600 ft. in dimensions. From this storage it is transferred, as wanted, to a car-loading machine.

(The operations of Armour Fertilizer Works, Charleston Mining Company. Hoover and Mason Phosphate Company, and Monsanto Chemical Company will be dealt with in the March issue)

(To be concluded)

INDO-CHINA and Its Mineral Wealth

Can Japan supply her needs of important commodities from this source?

S. E. Lavrov
Chief Engineer
Marsman Hongkong China, Ltd.
Hongkong, China

WHEN recently the Congress of the United States authorized the President to stop shipments of strategic materials outside of the Western Hemisphere, a blow was struck at Japan, which might ultimately lead to the collapse of her aggressive policy in China, because Japan is notably poor in strategic materials. This embargo prompted Japan to act quickly in getting the helpless French and the preoccupied British to close the Indo-China Railway and Burma highways respectively, to secure for themselves a still greater stranglehold on exhausted but grimly fighting China. However, this closing did not bring the desired capitulation of China, and Japan, thoroughly alarmed at the possibility of shortage of strategic commodities, decided to acquire such materials herself by conquering Indo-China. Her second reason for attacking Indo-China was that by an easy military success her starving war-weary population would be somewhat appeased, thus strengthening the militarist clique now in power.

By conquering Indo-China, Japan would drive a wedge between China and the Western powers, completely isolating her. She would dominate Burma, Siam, the Malay States, and the Great Island Empire composed of the Dutch and the British possessions in the Malay Archipelago. Most important is the fact that she would be able to do this without first conquering the territories mentioned but by developing Indo-China as a vast arsenal and storage place and then using the country as her jumping-off ground, for the conquest of the free countries remaining, one by one.

Starting in 1863, the French in the course of 20 years succeeded in putting the whole of Indo-China under "protection." From then up to the time of writing at least (August, 1940), the country has been governed by a French Governor-General appointed by Paris.

Politically, Indo-China is divided into the empire of Annam and the Kingdom of Cambodge and Laos, the Vice-Kingdom of Tongking, and the Colony of Cochin-China. Theoretically the Emperor and the Kings have held the power, but practically in each section the French *resident superieur* has been the most influential person.

Further, these five countries, as ruled by the French, have been subdivided into provinces under French residents (governors) and then into sections under native officials. Hanoi, a city of 152,000, is the administrative center of the country. The laws have been those of France modified to meet native requirements. All higher government officials, military as well as the police, have been French. The unit of money is the *piastre* of 100 cents, worth 20 cents, U. S. Currency, at the present rate.

The area and population of Indo-China as compared to the other countries mentioned are given in Table I, on page 54.

The populations, in millions, of the component parts of Indo-China, and their respective capitals, are as follows: Cochinchina, 4.5, capital, Saigon; Anam, 5.5, capital, Hue; Cambodge, 3, capital, Pnom-Penh; Laos, 1, capital, Ventiane; and Tongking, 8.5, capital, Hanoi.

This population is composed of: Annamites, 17,600,000; Khmers, 2,650,000; Laotians, 1,200,000; Chinese, 500,000; French, 50,000; and savage tribes, 1,000,000.

The native peoples are pursuing agriculture, the savage tribes hunting and fishing, and the Chinese trading, animal husbandry, and horticulture. Of the French males, about 10,000 are military, 5,000 Government officers, and 7,000 ordinary civilians.

The climate is tropical in the south and semi-tropical in the north. In the mountains it is much cooler. Rainfall is abundant and reaches 120 in. along the coast of Siam Gulf. Extensive forests cover all mountains and impenetrable jungles the valleys. Delta regions are devoted to rice cultivation. The animal life is abundant.

A large part of the country is mountainous. The Annamite chain, separating the Mekong basin from the China Sea, rises to about 10,000 ft. above the sea in central Annam and gradually

The author, at Hongkong

MR. LAVROV *is a graduate of Michigan College of Mines (1926). After working seven years for Federal Mining & Smelting Company in various capacities, from assayer to chief engineer, he went to the Far East in 1933, where for the following seven years he has been engaged in the examination of mines and mineral resources. Since 1936 he has been chief engineer for Marsman Hongkong China, Ltd. He has also served as consulting engineer to the Whampoa Port Development Administration in Canton and as advisor to the Kwangsi Provincial Government. In 1937 he was in charge of the first geological expedition to Hainan Island, remaining there six months. Mr. Lavrov has himself examined many of the deposits referred to in this article. In addition he has had access to the files and publications of the Department of Mines in Hanoi and other valuable sources. At the time of writing last August, he felt that invasion of Indo-China by Japan was imminent.*

descends to sea level at Saigon. In the north, this chain is connected with the Yünnan Mountains. Parallel to it are the mountain ranges of western Tongking stretching along the River Noir and the Fleuve Rouge and also rising to 10,000 ft. The deltas are formed by the Mekong River at Saigon and the Fleuve Rouge in Tongking.

Almost all geologic eras are represented in the formations exposed in the country. The orogenetic movement took place in Hercynian (Upper Permian) time and also at the end of Triassic period, giving intensive folds with overthrusts.

Taxes on the mining industry have not been excessive. There is a tax of approximately 8 per cent on dividends, but the initial tax on the formation of a company amounts to 10 per cent of the capital stock. In addition, there are production taxes on tungsten ores equivalent to $3.50 (U. S.) per ton. Other production taxes are given in Table II.

The principal ports are: Saigon, in the south of Indo-China and through which 2,000,000 to 2,500,000 tons is exported annually; Haiphong, situated in the northeast, which exports about 1,000,000 tons; and Hongay, only 20 miles east of Haiphong, which exports approximately 1,000,000 tons of coal per year.

The country is served by about 2,000 miles of railways connecting Hanoi with Saigon and other cities of importance. Highways suitable for motor traffic total 20,000 miles. Water transportation exists on the Mekong River and the Fleuve Rouge and its tributaries. Altogether, about 10,000 miles of navigable rivers is suitable for shallow-draft boats.

Mineral Resources—If a country is to be judged exclusively by the export statistics columns, Indo-China's record is not so impressive. Over a period of twelve years ended with 1938, the annual value of the country's mineral exports has ranged from a low of $3,000,000 (U. S.) in 1933 and 1934 to the high of $8,500,000 in 1938. However, as will be explained, the export of minerals is not indicative of the potential mineral resources of the country.

The meager showing has been due to the fact that many valuable deposits are situated in outlying parts of the country and, as the Colonial industries have not been developed, they would normally have to wait until such time as the country should become an industrial entity.

More would probably be known about the mineral resources of Indo-China were it not for the system of filing mining claims that has been in vogue. According to French law, any Frenchman for a fee of $7 has been able to stake an unpatented mining claim, which is a square with sides 3 km. long and running north and south.

Table I.—Population and Area

	Population, in millions	Area, 1,000 Sq. Mi.	Population Per Sq. Mi.
French Indo-China	23	285	81
Siam	12	200	60
Netherlands East Indies	65	733	89
Philippine Islands	12	114	106
Japan	65	148	437
China	490	4,278	115

This claim has been good for three years and after that period has been patentable for a fee of about $100, U. S. The claim so patented becomes a concession and, as things have been in the past, the owner has not had to do a tap of work on it unless he wished. The annual tax has been only $45, U. S., per square mile of patented ground.

Thus it has come about that as soon as word would get around that some mineral had been discovered in a certain locality, immediately there would be a rush to the mine office (Bureau de Mines) by promoters, who would stake claims all around the place where the strike had been made. These promoters have not even had to go to the spot where the discovery was made but merely to the book store, where they could procure an excellent map of the district (scale, 1-100,000). On this map they could scale off their claim and with this information in hand the Mine Office would register it as to priority and validity.

These claims have been staked in anticipation that the original discoverer would develop his property and that the promoters would derive benefit by selling their claims. Recently the Government realized the danger of this situation and a proposal was made whereby it would force the owners of the patented claim to do a certain amount of assessment work per year.

Still another reason for the lag in mine development is that the French have viewed mining in general as risky. During almost 60 years of occupation they seem to have been interested mainly in agriculture, where little capital was necessary. They even opposed industrialization of the country, as that would mean a drop of imports of manufactured articles from France.

Another drawback to regular mining development has been the attitude of the Colonial Government towards

Table II.—Production Tax on Minerals

	Dollars, U. S.
Tin	7.00 per ton
Cassiterite	10.00 per ton
Tin ore	0.40 per ton
Iron ore	0.05 per ton
Coal	0.05 per ton
Ground phosphate	0.10 per ton
Chromite	0.15 per ton
All other ores	0.50 per ton
Gold	8.00 per kg.

participation of foreigners in mining enterprises. The Colonial laws have prohibited foreigners from owning and exploiting mines. Three-quarters of the board of directors, the president, and the managing director have had to be French.

In addition there are the natural obstacles which have impeded the progress of mining. Until 1905 banditry made prospecting in Laos and northern Tongking practically impossible. The climate, moreover, is not propitious for prospecting, being hot and damp for nine months of the year. Absence of communications, dense forests and jungles which conceal outcrops, and the topography make prospecting difficult. Then there are the ever-present diseases of the tropics.

Strategic Minerals—Most economists agree that Japan is dependent on imports from abroad of iron, aluminum, antimony, chrome, copper, lead, zinc, manganese, mica, nickel, tin, tungsten, mercury, and phosphate. Of these, copper is the only mineral produced in considerable quantities in Japan, despite which she has to import about 20 per cent of her total requirements. Japan's production of lead, zinc, tin, manganese, and tungsten ranges between 5 and 50 percent of her requirements. Of chrome, nickel, antimony, and mercury she has none. Her position respecting the various key commodities and the supplies she might hope to obtain from Indo-China are discussed in the following paragraphs:

Coal—Japan is almost self-sufficient in coal and her exports of it almost balance the imports. Still it is interesting to note that her total coal reserves are estimated at about 10,000,000,000 tons, whereas those of Indo-China are placed at double the amount.

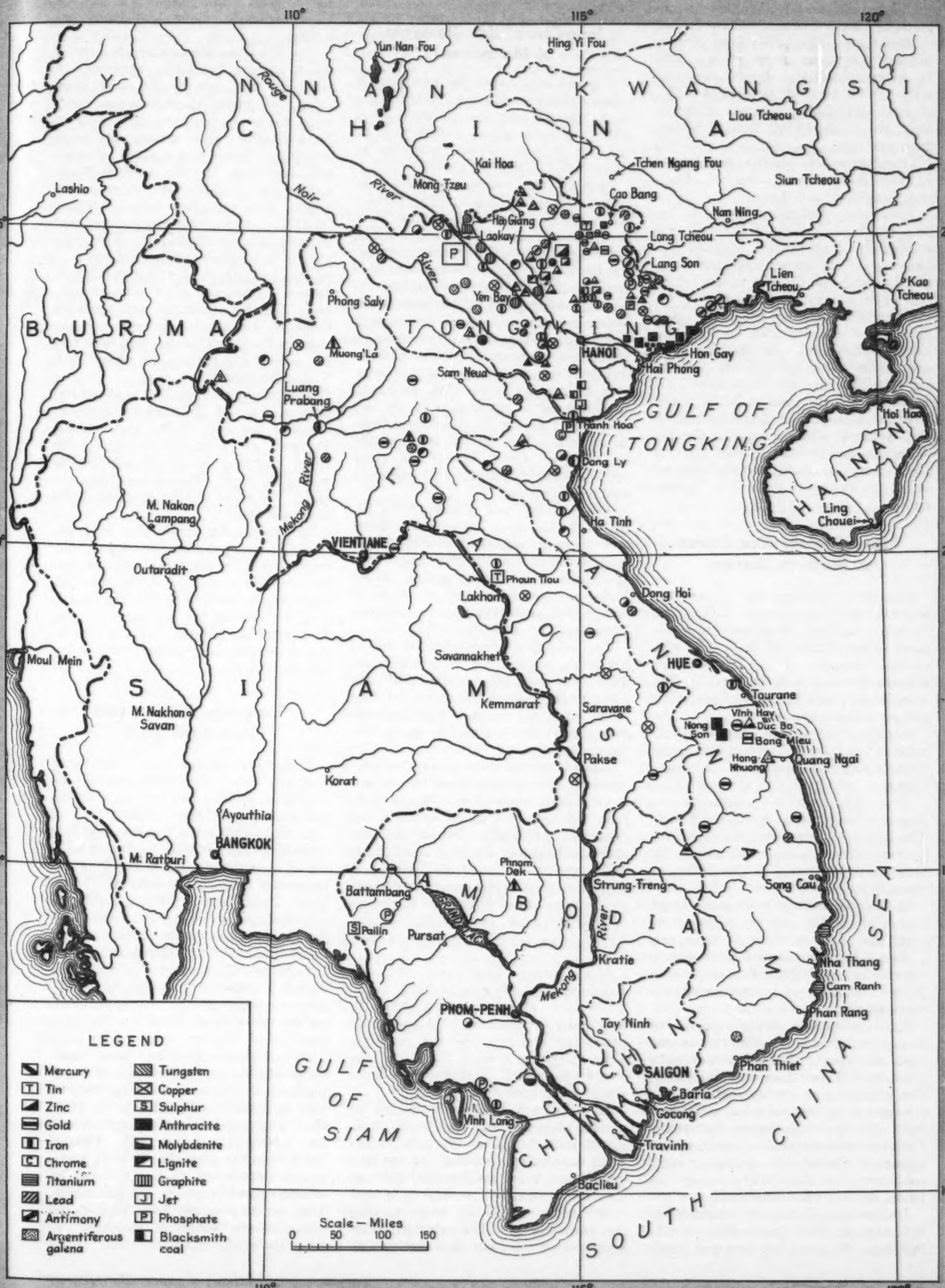
Coal mining is the most important mineral industry in Indo-China, and the value of production is about 50 per cent of the value of all other minerals combined, and amounts to about 2,500,000 tons valued at $4,000,000, U. S.

The most important coal region is only 20 to 30 miles northeast of Haiphong. The biggest mine in it is owned by the Soc. Francaise des Charbonnages de Tonkin, producing annually about 1,500,000 tons of anthracite. The coal dust (anthracite being very friable) of this mine is in great demand in Japan, as, when mixed with Japanese coal, it is suitable for making coke.

Iron—Japan is most vulnerable in the operation of her iron and steel industries, her deposits of iron ore consisting of only 80,000,000 tons and most of her coals not being of the coking type.

In Indo-China, known deposits of

INDO-CHINA'S MINERAL RESOURCES



iron ore do not exceed several million tons and acquisition of the country by the Japanese would not help in alleviating their shortage of iron ores.

Aluminum—The importance of aluminum in airplane construction cannot be overemphasized. Japan produced only 15,000 tons of bauxite in 1937. It is estimated that for war purposes only, she needs 40,000 tons of aluminum per year.

Occurrences of bauxite are known in Indo-China around Long Son, Eastern Tongking, and Laos.

Antimony—Antimony mining in Japan was once important but has now completely disappeared, due to exhaustion of the richer ores and competition with the Chinese mines, which can operate very economically.

In Indo-China there are many small mines and a profitable undertaking can be established. In the Cao-Bang area alone there are deposits containing 250,000 tons of marketable ore. Situated off the beaten track, they have not been exploited systematically. This resource would be useful for the Japanese, for the reason that most of the Chinese antimony mines, situated in Hunan Province, are still in Chinese hands.

Some Chrome Ore Found in Northern Annam

Chromite—Chrome ore is another mineral which is totally lacking in Japan. In Indo-China, on the other hand, there exists at least one rich chrome deposit. It is in northern Annam, 100 miles from Hanoi. The tonnage is about 2,000,000 tons of 52 per cent Cr_2O_3 concentrate.

Copper—In copper, Japan is almost self-supporting and of this metal hardly any deposits exist in Indo-China.

Lead—The annual production in Japan is only about 10,000 short tons. The country's war requirements (for an army of one million soldiers in the field) are estimated at 250,000 tons annually.

In Indo-China one finds many small lead-silver mines. On the whole, however, lead production is unimportant.

Zinc—Japan's production of zinc is approximately 50,000 tons per year, or 20,000 tons short of her estimated war requirements.

Indo-China has ample reserves of zinc. The metal is the country's second most important. The biggest deposits are found in north-central Tongking. The original zinc ore is sphalerite, and it occurs in quartz veins or as kidneys and pockets in Paleozoic limestones. Present exploitation is confined to upper levels of the oxidized zone, calamine and smithsonite being the principal minerals produced.

Production of zinc ore reached 50,000 tons in 1925 (equivalent to 25,000 tons of zinc), but dropped lately to an average of 15,000 to 20,000 tons per annum. No doubt the output can be substantially increased.

Indo-China Has Reserves of Manganese

Manganese—Japanese reserves of manganese are negligible (400,000 tons in Formosa) and the production in 1936 was only about 70,000 tons of ore per annum. Japan now has to import about 200,000 tons.

Though little manganese ore has been produced in Indo-China, her reserves are by no means negligible. Producing mines are situated around Yen Cu near Vinh, in northern Annam. Production is about 10,000 tons per annum, all of it shipped to Japan.

Many occurrences of manganese ore have been reported from northeastern Tongking. There is, for example, a commercial deposit of about 25,000,000 tons which has not as yet been even thoroughly prospected, owing to the low price of manganese in the last decade and also to its remoteness from the railway. This deposit, if connected by rail with Long Son, would make an important contribution to Japanese war requirements.

Mica, Nickel, and Mercury—No deposits are known in Indo-China. However, there are chances that some nickel may be found in the highly basic rocks (peridotite) stretching along River Noire and an occurrence of cinnabar is reported near Hagiang, in northern Tongking.

Tin—Japan's production of tin is negligible, amounting to several hundred tons annually. In 1938 she was consuming 11,000 tons of the metal and her annual war-time requirements are estimated at double that quantity.

Barred temporarily from the conquest of Netherlands East Indies and anticipating trouble with Great Britain, the country which controls the deposits of Malaya, Japan may be expected to try to develop considerable resources of tin in Indo-China and force her way to the producing areas of Yünnan and Kwangsi provinces in China, close to the Indo-China border, and later on to Burma and Siam.

Indo-China's production of tin amounted to 2,300 tons in 1937. Also, 2,600 tons of ore was exported to Singapore for smelting. The principal producing districts are the Nam Pa Tene valley, in central Laos, and the Pia Ouac region northwest of Cao-Bang, in northern Tongking.

In the Laos region tin occurs as eluvial deposits of cassiterite associated with limonite. It is a superficial alteration product of pyritic veins which carry cassiterite. The cassiterite is usually fine and is coated with brown oxide of iron, making recognition hard. The principal characteristic of the Laos ores distinguishing them from the ore of Pia Ouac is the absence of tungsten minerals in the former. Tin production of the Laos region is about 1,000 tons annually.

The Pia Ouac Mountains are formed by a granite batholith, bordered on the north and east by the Sang Hien schists of Permo-Carboniferous (perhaps Triassic) age and on the west by Devonian rocks, gneiss, and mica schists. These rocks show distinct metamorphism in the contact zone, and in the metamorphic aureole thin quartz veins are often found carrying cassiterite and wolframite, sometimes forming a large stockwork. The veins are of two types, those without sulphides and others carrying sphalerite, galena, pyrite, and other sulphur minerals. In this aspect the ores resemble those of Cornwall. Erosion of the stockworks provided tin and wolfram for several big placers, of which Tinh Tuc is the biggest.

The output of Tinh Tuc is about 200 tons of tin and 250 tons of tungsten ore (60 per cent WO_3) per annum. Reserves are estimated at 70,000,000 cu.yd. carrying 0.8 lb. of metallic tin per cubic yard. Production from the entire Pia Ouac district is about 1,000 tons per annum.

In general, tin production in Indo-China, when properly developed, can easily reach a substantial figure and surpass the quota of 3,000 tons allotted to the country by the Tin Cartel.

If in addition the Japanese manage to capture the Yünnan deposits, Japan will be almost independent of foreign sources for tin.

Tungsten, Sulphur and Phosphate Rock

Tungsten—Japan has developed tungsten mines in Chosen (Korea) so that she produced 1,910 tons of 60 per cent concentrates in 1936.

In Indo-China the tungsten-tin belt extending from China is found near Cao-Bang, and tungsten deposits are numerous throughout northeast Tongking. Production in 1936 was 302 tons of concentrates and in 1937 400 tons. In the last two years it has almost doubled and could be increased further.

Sulphur—This mineral is found in Japan in sufficient quantities to satisfy domestic requirements. In Indo-China, on the other hand, there are no large deposits of sulphur or of pyrite ores.

Phosphates—Japan has been steadily increasing her importation of phosphate rock. It has risen from 265,088 tons in 1925 to 825,812 tons in 1938. Her consumption of superphosphate was 1,009,722 tons in 1933. Thus it can be readily seen that it is of paramount importance to her to have an uninterrupted supply of phosphate. This can be obtained from Indo-China when known extensive deposits are properly exploited.

As it is, in Indo-China approximately 30,000 tons of phosphate is produced per annum, principally in southern Tongking and Annam. Deposits there occur in vein-like masses and in pockets in limestone caves. The principal occurrences are in the region of Long Son (western Tongking), near Thai Nguyen (central Tongking), near Song Chay, and along the Fleuve Rouge. In Annam some deposits are known at Thanh Hoa, in Vinh and Dong Hoi.

In Cambodge there are at least two localities, one in the south at Kampot and the other near Battambang, where there are deposits. The combined tonnage of these scattered deposits in all probability does not exceed several million tons.

The most important deposits, as yet hardly touched, are those of Lao Kay region. Situated within a few miles of the trunk line connecting Hanoe and Kunming (capitals of Indo-China and Yünnan province respectively), and lying on the bank of the Fleuve Rouge, they will certainly play a big part in any Japanese scheme. The probable tonnage of high-grade rock is at least 10,000,000 and, including the lower grades, close to 50,000,000 tons of phosphate is believed to be in evidence.

Summary

From the foregoing analysis of the mineral situation in Indo-China it is evident that Japan, after a period of development, will be able to augment her supply, thereby to satisfy her demands, wholly or in greater part, of the following strategic minerals to be acquired by conquest or domination of Indo-China:

1. *Phosphate*—Indo-China will be able to supply the entire demands of Japanese industry for phosphate as soon as the Lao Kay deposits are brought into production.

2. *Manganese*—Deposits in Indo-China can be brought into production in a short time and developed to supply the entire needs of Japanese.

3. *Zinc*—Japanese production can be augmented by 20 percent of the present production capacity of Japan.

4. *Chromium*—Chrome ore is certainly available in Indo-China and, even in the free-market mining of it, a profitable enterprise may be developed.

5. *Antimony*—Mining of this metal in Indo-China could be developed and production increased almost immediately.

6. *Tin*—Production of tin in Indo-China can be easily increased. If Chinese mines in Yünnan are captured, their combined production should satisfy present Japanese demands.

7. *Tungsten*—Production in Indo-China can also be increased so as to provide a substantial portion of Japanese requirements.

In respect to the following key commodities, Japan either does not need additional supplies or cannot look to Indo-China as a source of supply of them:

1. *Copper*—Being almost self-sufficient in copper, the Japanese will hardly notice the lack of this mineral in Indo-China.

2. *Coal*—In coal Japan could immediately augment her production by 10 per cent and probably raise it further in the future.

3. *Aluminum*—In the supply of aluminum Indo-China's resources do not appear promising for the immediate future.

4. *Iron*—There are no immediate prospects of increasing production of iron in Indo-China. Consequently, Japan will have to look to other sources.

5. *Lead*—There are no immediate prospects as to the development of lead mines in Indo-China.

▼ ▼ ▼

Renewed Field Coils Prolong Armature Rewind Life

THE INTERNAL CONDITION of the main and commutating field coils in any series-type motor influence the useful life that can be obtained from a rewound armature, writes A. C. Roe, Engineering Division, Westinghouse Electric & Manufacturing Company. Most maintenance programs recognize that field coils with defective external ground insulation are a hazard and must be eliminated. But few maintenance programs take into account the destructive effect of defective internal field coil insulation on motor operation; that is, short armature life, rapid brush wear, excessive sparking, rapid deterioration of ground insulation on good field coils, and pitting of commutator face. Many of these are traceable to internally defective field coils.

It has been proved by trial that good preventive maintenance requires the removal of all field coils (main and commutating) from the frame of any motor that has been shopped for armature burn-out, grounded or shorted field coils, even if only one field coil is known to be defective.

The practice of using only good field coils for rewound armatures has paid dividends in mining operations. At one large property the armature rewinds per year decreased from 204 to 94, although the tonnage of mined material was almost doubled.

All field coils removed should be carefully checked for weak internal insulation and shorts between turns. Doubtful coils should be scraped or rewound with new turn insulation. When the practice of removing all field coils has been established the following rules should be made effective:

1. When re-fielding, never mix old or repaired field coils with new coils in any one frame.

2. Use either all new field coils, or all rebuilt field coils in the one frame.

3. Don't put one or more new field coils in with old coils for quick temporary repairs of this type. Use rebuilt coils.

4. Be certain that the polarity of all coils is correct, as wrong polarity will soon burn out a good armature.

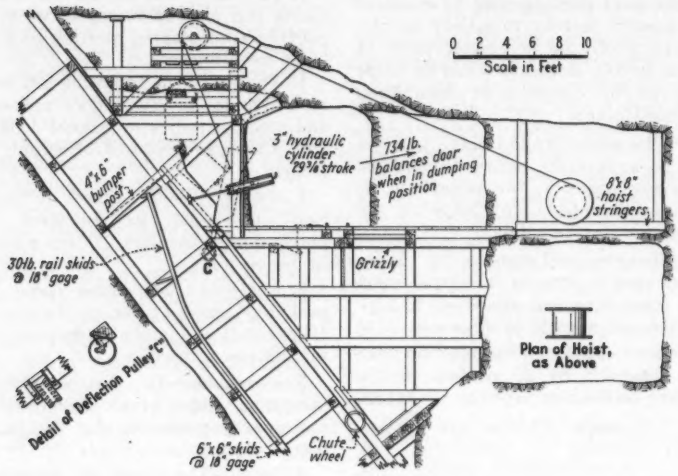
5. For rewound armatures use only a frame that has all good field coils.

This practice is based on the fundamental principle of the series motor, where the current flowing in the armature and field circuit is of the same value. The field coils consist of a relatively few turns of a large-size conductor where one field coil turn has a high ampere-turn value. The motor torque is proportional to the product of the field strength and armature current. Also, for any change in field flux or ampere turns, the armature tends to adjust its speed to develop the proper balancing counter-electromotive force to maintain the proper current value.

Therefore, when field coils have internal defects such as short-circuited turns, the resistance of the field circuit is lowered, and the field coil with shorted turns has a lower resistance than a normal coil with consequent lower ampere turns. Thus the tendency is to weaken the field, and the motor will tend to draw more current for the same load if the armature cannot speed up.

The net result is that the remaining good field coils will heat up while the shorted coils will be at a lower temperature than the good coils, or the defective coil or coils are the coolest coils. Thus one or more short-circuited field coils impose an overload on the remaining good coils in the motor. Under these conditions the armature may be overloaded, causing it to burn out. When this occurs the fields are overloaded still further and may be weakened to the point of failure when the motor is again placed in service.

USEFUL OPERATING IDEAS


0 2 4 6 8 10
Scale in Feet
3" hydraulic cylinder 29⅜ stroke
734 lb. balances door when in dumping position
8"x8" hoist stringers
4"x6" bumper post
30lb. rail skids @ 18" gage
Grizzly
Plan of Hoist, as Above
Detail of Deflection Pulley "C"
6"x6" skids @ 18" gage
Chute wheel

Bucket Layout for Shaft-Sinking

AN INNOVATION at the property of Lava Cap Gold Mining Corporation near Nevada City, Calif., that makes possible shaft-sinking operations without interference with regular hoisting, elimination of waste transfer by cars at the transfer point, and greater sinking speed at maximum safety, is the bucket-dumping arrangement explained in detail in the accompanying line drawing. It is used both in the Banner and Central shafts sunk at an angle of 51 deg.

The Central shaft, which is now being deepened, contains two skipways and a manway measuring 4x5 ft. and 3x5 ft. respectively. The loading pockets in the shaft, divided between the skipways for ore and waste, are cut during sinking and are timbered as one unit with the shaft. In regular hoisting, loading of skips is effected through rack-and-pinion gates and small movable steel lips.

During shaft-sinking operations, material broken by the crew below the last shaft pocket is hoisted in 1,000-lb. steel buckets operating on skidways made up of 6x6-in. timbers, spaced 18 in., and terminating in 30-lb. rails at the transfer point. These are angled across the shaft below the pentice and subsequently extended down through the center compartment. Hoisting is done through the manway, with the skip compartments being bulkheaded with two sets of rock just below the skip pockets. The buckets are actuated by a one-drum Hendrie Bolthoff hoist, and dumped by the tail chain-trapdoor system shown. The waste is dumped directly into the station pocket and transferred to the surface in the regular hoisting skips.

Details of the deflection pulley below the trapdoor are also shown. The trapdoor, which forms a part of the operating floor when not in use, is operated by a 3-in. hydraulic cylinder with a 29⅜-in. stroke. Since adoption of the arrangement, the complete sinking cycle—that is, drilling, blasting, mucking, and timbering—is finished in two shifts, with four men employed on each shift, instead of three shifts formerly required. Average daily advance is 5 ft.

Operations at the property are directed by Otto E. Schiffner. John W. Chandler, general superintendent, kindly supplied the data given.

▼

Scale for Reading Pulp Density

WHILE mill superintendent for the Maxwell Land Grant Company's Aztec Mines at Ute Park, N. M., M. A. Cook devised the apparatus described here for instantly checking both specific gravity and per cent solids in mill pulps. It eliminates the time and trouble involved in the usual counter-balancing of a given volume of pulp and the subsequent reference to charts, since both specific gravity and per cent solids are read off directly when the can of pulp is hung on the scales. Mill men were found to maintain densities more consistently with this apparatus than with the usual type of balance.

The apparatus consists of a dial-type dairy scale of 15-lb. capacity and a 1-gal. diamond-drill sludge sample can or similar container. The dial is calibrated in pounds by tenths; and, in addition to the usual fixed indicator, the scales have an adjustable indicator which can be set at zero with the empty can on the hook, thus giving net weight when the can is full of pulp. The only alteration is that of recalibrating the dial to read density and per cent solids. This can be done by gluing a blank disk of some water-repellant paper over the dial. This disk should be of a smaller diameter than the dial, so that the pound graduations can still be read.

Calibration is simple and may be done in the office as follows: Assume the can full of pulp at 60 per cent solids and the specific gravity of ore as 2.70. From pulp density relations tables a pulp containing 60 per cent solids, the solids having a specific gravity of 2.70, has a density or specific gravity of 1.607; and, since we have one gallon of pulp, the weight of the pulp equals 8.345 x 1.607, or 13.41 lb. One gallon of water, specific gravity 1.00, weighs 8.345 lb.

On the blank scale in the space for gravity mark 1.61 opposite 13.41 lb.; and immediately below mark 60 per cent as shown on the sketch. Following the same procedure, mark off 25 per cent as also shown. Thus the dial can be completely graduated or only in the density ranges common at the point where the checks are to be made.

Any size can may be used, provided the volume be determined in some manner such as filling it with water, hanging on the scale and noting the weight of the water, the adjustable pointer having previously been set at zero with the empty can on the scales. This weight in pounds is then converted to gallons by dividing by 8.345, from which point calculations can be carried on as described.

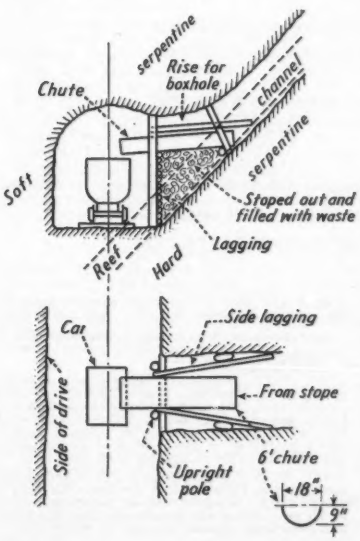
Stope Box Hole From South Africa

THE DEVELOPMENT of a new type of stope box hole has been found such a great improvement, under the conditions described, that it is thought it might be advantageously adopted under like conditions elsewhere, writes W. E. Sinclair, Cape Asbestos Company, Koegas, South Africa. In the accompanying sketch a section shows a box hole opening from the bottom of a stope into a drive. Owing to the extremely hard footwall formation, driving is carried in the soft serpentine country, which means that the reef instead of being carried shoulder high occurs in the footwall of the drive.

Following normal practice, the reef was stoped out as shown and after the construction of the usual timbered box-hole the space below was filled with waste. The 9x3-in. deal lining of the box hole added to the difficulty of the flat inclination by tending to prevent movement of the broken ore and consequent blocking of the box. The asbestos ore being handled rather aggravated the trouble because of its tendency to clog on any but steeply inclined surfaces.

The construction as shown obviated this difficulty because the ore can be easily moved along the steel chute by one man, as there is more room in which to work and the material slides more easily on steel than on wood.

The steel chute box takes just a quarter of the time to put in compared with the construction of the usual type and costs less than half as much, because the steel chutes last indefinitely and are simply moved up to a new position as the stope face advances.



Mike Amersek setting teeth in a circular saw with the setting tool

Novel Saw-Setting Device

THE accompanying photograph shows a simple, indispensable tool developed and put in use recently at the timber-framing shed of United Verde Branch, Phelps Dodge Corporation, Jerome, Ariz. It is used for automatically setting teeth in conventional and circular saws, Mike Amersek, an employee in the timber framing department, worked up all details, and the device was made in the company machine shop.

As will be seen, setting of the saw teeth is accomplished by means of impact blows from a foot-operated hammer. The saw is inserted between a punch, or set, and an adjustable tapered block, and is held in place by a clamp which automatically opens and closes as the hammer rises and falls. The hammer first strikes the punch, which bends the tooth of the saw over the tapered block. On the vertical rod extending from the foot lever to the hammer there are a catch for holding the hammer up while the saw is being inserted and a knee-operated lever for releasing the hammer at the desired time. These levers can be adjusted so that the hammer may be raised to any desired height, and hence give any required force of impact. A special adapter is used for setting teeth in circular saws.

One of the advantages claimed is that the device will set teeth in any saw regardless of size or shape. The average time required to set a 28-in. hand saw is about 2 min., and a 42-in. tuttle-tooth crosscut saw 1½ min.

Five Dollars for Contributions

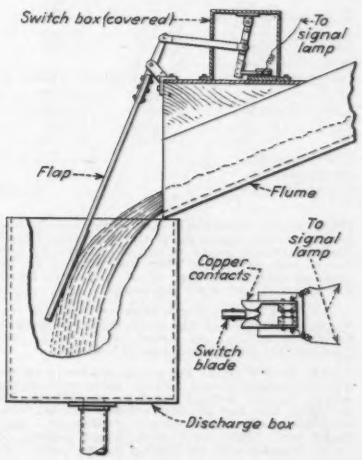
SHORT CONTRIBUTIONS to this Department are invited by the editors of E. & M. J. Five dollars will be paid for acceptable items of interest to engineers, master mechanics, electricians, and others responsible for the operation and maintenance of mining, milling, and metallurgical plants in the field covered by this publication.

Thickener Alarm

TO THE MILL MAN familiar with thickener operations, it is not necessary to make any explanations as to what would happen if some breakdown of the diaphragm pumps or rake mechanism should occur without being detected by the operator. Broken rakes, twisted rake shafts, overflows, and other difficulties may result. Hence, the need for a dependable alarm system.

The accompanying sketch shows a device that has given excellent service at the concentrator of Magma Copper Company, Superior, Ariz. It was developed by members of the concentrator staff, and is installed at the end of the wooden launder handling thickener underflow. Essential parts, all made from scrap materials, include a simple switch housed in a small box, and a lever-operating mechanism.

Operation is relatively simple. As long as the flow of thickener pulp in the launder remains normal, the contact, which is a signal lamp circuit, is closed, but should the flow suddenly cease, the long wooden flap hinged to the steel fork at the end of the launder will immediately fall into a vertical position, with the connecting lever pulling out the switch blade and thus extinguish the signal lamp which is on the mill operating floor.



Summary of the

MARKETS

THOUGH the year 1940 ended with industrial activity and consumption of raw materials at the highest point on record, prices for major non-ferrous metals showed no marked variation during December. In fact, the *E.&M.J.* index of prices dropped slightly, reflecting lower averages for lead, tin, and aluminum. The index for December was 82.42, against 83.14 in November and 82.89 in December, 1939. For all of 1940, the index number was 79.22, which compares with 77.71 in 1939, 73.67 in 1938, and 90.86 in 1937.

The outstanding event in copper was the entry of the Government as a factor in the market by purchasing 100,000 tons of Latin American metal at 10c. a pound through the Metals Reserve Company, Washington. This large stock will serve as a cushion against "emergency" needs here, and at the same time aid in the hemisphere defense program, the trade believes. The announcement took some bullish price ideas out of both buyers and sellers. Sales of copper in the domestic market during December amounted to 90,164 tons, against 85,004 tons in November. Large mine operators held to 12c., Valley, throughout the month, whereas consumers who insisted on obtaining nearby copper had to pay a little more from other sources. As the month ended, export copper sold at 10.250c., f.a.s. New York. A fair tonnage of foreign-origin copper was used during December on British orders for fabricated materials.

Lead was reduced to 5.50c., New York, on Dec. 2. Buying moderated and custom smelters found that they were accumulating metal. Stocks of domestic refined lead increased slightly. Zinc supply remained tight, with producers allocating business on the 7¼c., St. Louis, basis. Tin was in ample supply at moderately lower prices. The Government was a buyer.

Quicksilver met with support as the month ended on buying against purchases of oxide for the Navy. Foreign manganese and chrome ore prices were nominal, because of uncertain shipping conditions.

UNITED STATES MARKET

1940 Dec.	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
2	11.775	10.250	50.200	5.50	5.35	7.25
3	11.775	10.300	50.200	5.50	5.35	7.25
4	11.875	10.200	50.200	5.50	5.35	7.25
5	11.800	10.200	50.200	5.50	5.35	7.25
6	11.825	10.300	50.100	5.50	5.35	7.25
7	11.825	10.250	50.100	5.50	5.35	7.25
9	11.800	10.200	50.075	5.50	5.35	7.25
10	11.800	10.200	50.050	5.50	5.35	7.25
11	11.775	10.200	50.050	5.50	5.35	7.25
12	11.850	10.200	50.050	5.50	5.35	7.25
13	11.775	10.200	50.050	5.50	5.35	7.25
14	11.775	10.250	50.050	5.50	5.35	7.25
16	11.775	10.450	50.050	5.50	5.35	7.25
17	11.875	10.300	50.050	5.50	5.35	7.25
18	11.875	10.450	50.100	5.50	5.35	7.25
19	11.775	10.350	50.100	5.50	5.35	7.25
20	11.825	10.400	50.100	5.50	5.35	7.25
21	11.775	10.375	50.100	5.50	5.35	7.25
23	11.775	10.375	50.100	5.50	5.35	7.25
24	11.775	10.350	50.100	5.50	5.35	7.25
25			Holiday			
26	11.775	10.350	50.100	5.50	5.35	7.25
27	11.825	10.325	50.100	5.50	5.35	7.25
28	11.775	10.325	50.100	5.50	5.35	7.25
30	11.800	10.325	50.100	5.50	5.35	7.25
31	11.775	10.200	50.100	5.50	5.35	7.25
			AVERAGES FOR MONTH			
Dec.	11.802	10.293	50.101	5.500	5.350	7.250
Dec.			AVERAGES FOR WEEK			
4	11.798	10.121	50.225	5.575	5.425	7.250
11	11.804	10.225	50.096	5.500	5.350	7.250
18	11.821	10.308	50.058	5.500	5.350	7.250
25	11.785	10.370	50.100	5.500	5.350	7.250
Dec.			CALENDAR WEEK AVERAGES			
7	11.813	10.250	50.167	5.500	5.350	7.250
14	11.796	10.208	50.054	5.500	5.350	7.250
21	11.817	10.388	50.083	5.500	5.350	7.250
28	11.785	10.345	50.100	5.500	5.350	7.250

SILVER, GOLD AND STERLING EXCHANGE

1940 Dec.	Sterling Exchange: "Checks" (Nominal)	Sterling Exchange: "90-day demand"	Silver: (c) New York	Silver: London	Gold: London	Gold: (d) United States
2	402.000	(f)	34.750	22.8125	168s	$35.00
3	402.000	(f)	34.750	22.8125	168s	35.00
4	402.000	(f)	34.750	22.9375	168s	35.00
5	402.000	(f)	34.750	22.9375	168s	35.00
6	402.000	(f)	34.750	23.0000	168s	35.00
7	402.000	(f)	(e)	(e)	(e)	35.00
9	402.000	(f)	34.750	22.8750	168s	35.00
10	402.000	(f)	34.750	23.0625	168s	35.00
11	402.000	(f)	34.750	22.8750	168s	35.00
12	402.000	(f)	34.750	22.8750	168s	35.00
13	402.000	(f)	34.750	22.8750	168s	35.00
14	402.000	(f)	(e)	(e)	(e)	35.00
16	402.000	(f)	34.750	23.0000	168s	35.00
17	402.000	(f)	34.750	22.9375	168s	35.00
18	402.000	(f)	34.750	23.0000	168s	35.00
19	402.000	(f)	34.750	23.0000	168s	35.00
20	402.000	(f)	34.750	23.0625	168s	35.00
21	402.000	(f)	(e)	(e)	(e)	35.00
23	402.000	(f)	34.750	23.1250	168s	35.00
24	402.000	(f)	34.750	23.2500	168s	35.00
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
26	402.000	(f)	34.750	23.2500	168s	35.00
27	402.000	(f)	34.750	23.1250	168s	35.00
28	402.000	(f)	(e)	(e)	(e)	35.00
30	402.000	(f)	34.750	23.1875	168s	35.00
31	402.000	(f)	34.750	23.3125	168s	35.00
			AVERAGES FOR MONTH			
Dec.	402.000	.....	34.750	23.015	....	35.00
Dec.			AVERAGES FOR WEEK			
4	402.000	.....	34.750	.....	....	.....
11	402.000	.....	34.750	.....	....	.....
18	402.000	.....	34.750	.....	....	.....
25	402.000	.....	34.750	.....	....	.....

Calendar week averages, New York Silver: Dec. 7th, 34.750; 14th, 34.750, 21st, 34.750; 28th, 34.750.

(e) Not quoted (Saturday). (f) No quotations.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotations deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade Zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout December.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940 Dec.	Copper Standard Spot	Copper Standard 3 months	Copper Electro Bid	Tin Standard Spot	Tin Standard 3 months	Lead Spot Buyers	Lead Spot Sellers	Lead 3 months Buyers	Lead 3 months Sellers	Zinc Spot Buyers	Zinc Spot Sellers	Zinc 3 months Buyers	Zinc 3 months Sellers
2	Not quoted			257.7500	260.0000	Not quoted							
3	"	"	"	257.5000	260.0000	"	"	"	"	"	"	"	"
4	"	"	"	257.5000	260.0000	"	"	"	"	"	"	"	"
5	"	"	"	256.7500	259.7500	"	"	"	"	"	"	"	"
6	"	"	"	257.0000	259.7500	"	"	"	"	"	"	"	"
9	"	"	"	256.7500	259.7500	"	"	"	"	"	"	"	"
10	"	"	"	256.7500	259.7500	"	"	"	"	"	"	"	"
11	"	"	"	256.5000	259.7500	"	"	"	"	"	"	"	"
12	"	"	"	257.0000	259.7500	"	"	"	"	"	"	"	"
13	"	"	"	257.0000	260.0000	"	"	"	"	"	"	"	"
16	"	"	"	257.0000	259.7500	"	"	"	"	"	"	"	"
17	"	"	"	257.2500	260.0000	"	"	"	"	"	"	"	"
18	"	"	"	257.2500	260.2500	"	"	"	"	"	"	"	"
19	"	"	"	257.0000	259.7500	"	"	"	"	"	"	"	"
20	"	"	"	257.0000	259.7500	"	"	"	"	"	"	"	"
23	"	"		257.2500	260.0000	"	"	"	"	"	"	"	"
24	"	"	"	257.0000	259.7500	"	"	"	"	"	"	"	"
25	Holiday												
26	Holiday												
27	Not quoted			256.5000	259.7500	Not quoted							
30	"	"	"	256.5000	259.7500	"	"	"	"	"	"	"	"
31	"	"	"	256.5000	259.7500	"	"	"	"	"	"	"	"
Average for month				256.988									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Jan. 2, 1941)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	17c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$164.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$32.00@$34.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$64.54
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 55c.
50 @ 52 per cent	(b) 55c.
46 @ 48 per cent	(b) 48@50c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$26.00
Domestic, 65 per cent and upward	(a) $23.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$48.00

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3½c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.75
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$17.00@$18.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 percent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90@$2.00
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90

NON-METALLIC MINERALS

Asbestos, f.o.b. mines (U.S. funds), ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$13@$17.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$7.00@$8.00
Domestic, abrasive, 80 @ 84 per cent	$14.00
Dalmatian, 50 @ 55 per cent	Nominal
French, 56 @ 59 per cent	Nominal
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	45@60c.
2 x 2 in.	60@80c.
3 x 3 in.	$1.25@$1.50
3 x 4 in.	$1.50@$1.75
3 x 5 in.	$1.75@$2.25
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	34.750	20.370	20.935	468.472	395.652
March	42.750	34.750	20.280	20.763	468.370	375.212
April	42.750	34.750	20.031	20.713	467.778	351.817
May	42.750	34.949	20.123	21.878	467.988	326.452
June	41.955	34.825	19.505	22.688	468.137	359.560
July	34.944	34.750	16.952	22.095	468.031	379.750
August	35.951	34.750	17.719	23.261	460.383	396.889
September	36.956	34.750	22.178	23.446	398.820	401.646
October	35.726	34.750	22.736	23.451	400.350	401.692
November	34.750	34.750	23.378	23.238	391.457	401.783
December	34.956	34.750	23.263	23.015	391.830	402.000
Year	39.082	34.773	20.570	22.281	443.199	382.325

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440	(b)
February	11.025	11.148	9.735	11.471	42.188	(b)	47.375	(b)
March	11.025	11.160	9.888	11.407	42.938	(b)	48.120	(b)
April	10.265	11.087	9.820	11.258	42.031	(b)	47.833	(b)
May	9.833	11.079	9.738	11.191	41.656	(b)	47.528	(b)
June	9.775	11.128	9.738	11.216	41.986	(b)	47.528	(b)
July	9.976	10.564	9.944	10.189	42.899	(b)	48.863	(b)
August	10.261	10.708	10.211	9.851	44.685	(b)	50.409	(b)
September	11.635	11.296	11.685	9.849	(b)	(b)	(b)	(b)
October	12.215	11.826	12.491	10.436	(b)	(b)	(b)	(b)
November	12.275	11.800	12.929	10.084	(b)	(b)	(b)	(b)
December	12.275	11.802	12.631	10.293	(b)	(b)	(b)	(b)
Year	10.965	11.296	10.727	10.770	(c)42.689	.....	(c)48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	5.076	4.655	4.926	14.283	14.417	(a)	(a)
March	4.824	5.192	4.674	5.042	14.660	14.860	(a)	(a)
April	4.782	5.071	4.632	4.921	14.337	14.533	(a)	(a)
May	4.750	5.015	4.600	4.865	14.483	14.679	(a)	(a)
June	4.800	5.000	4.650	4.850	14.564	14.651	(a)	(a)
July	4.854	5.000	4.704	4.850	14.753	14.856	(a)	(a)
August	5.043	4.854	4.893	4.704	16.040	15.885	(a)	(a)
September	5.449	4.929	5.299	4.779	(a)	(a)	(a)	(a)
October	5.500	5.308	5.350	5.158	(a)	(a)	(a)	(a)
November	5.500	5.726	5.350	5.578	(a)	(a)	(a)	(a)
December	5.500	5.500	5.350	5.350	(a)	(a)	(a)	(a)
Year	5.053	5.179	4.903	5.029	(b)14.707	(b)14.828	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits New York		Standard, Spot London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	45.851	213.906	242.833
March	46.213	47.079	215.375	251.711
April	47.160	46.815	218.389	252.080
May	49.031	51.570	225.591	264.098
June	48.853	54.618	227.511	273.438
July	48.548	51.591	229.833	265.592
August	48.793	51.176	229.869	262.455
September	64.588	50.348	229.292	251.024
October	55.580	51.490	229.943	257.946
November	52.322	50.577	230.000	258.214
December	50.740	50.101	248.974	256.988
Year	50.323	49.827	226.177	256.425

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	5.534	13.522	13.780	(a)	(a)
March	4.500	5.750	13.728	13.961	(a)	(a)
April	4.500	5.750	13.443	13.637	(a)	(a)
May	4.500	5.803	13.717	13.938	(a)	(a)
June	4.500	6.235	14.023	14.223	(a)	(a)
July	4.516	6.250	14.235	14.435	(a)	(a)
August	4.719	6.389	14.628	14.761	(a)	(a)
September	6.104	6.920	(a)	(a)	(a)	(a)
October	6.500	7.250	(a)	(a)	(a)	(a)
November	6.500	7.250	(a)	(a)	(a)	(a)
December	5.980	7.250	(a)	(a)	(a)	(a)
Year	5.110	6.335	(b)13.872	(b)14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pound sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.038	20.000	20.000
February	55.000	80.000	20.000	20.000
March	54.259	80.000	20.000	19.769
April	50.000	80.000	20.000	19.000
May	50.000	80.000	20.000	19.000
June	50.000	80.000	20.000	19.000
July	50.000	80.000	20.000	19.000
August	53.704	80.000	20.000	18.000
September	64.200	80.000	20.000	18.000
October	74.600	80.000	20.000	18.000
November	75.000	80.000	20.000	17.522
December	75.000	80.000	20.000	17.000
Year	59.180	79.920	20.000	18.691

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	14.000	85.227	178.000	35.000	40.000
March	11.269	14.000	87.278	180.921	35.000	40.000
April	11.500	14.000	90.300	173.538	35.000	38.923
May	11.712	14.000	86.769	181.538	35.000	38.000
June	12.000	14.000	86.615	197.360	35.000	38.000
July	12.000	14.000	86.960	194.423	35.000	38.000
August	12.000	14.000	84.407	184.111	35.333	38.000
September	12.910	14.000	140.000	173.333	40.080	36.167
October	14.000	14.000	145.600	168.846	41.120	36.000
November	14.000	14.000	134.978	168.391	40.000	36.000
December	14.000	14.000	141.200	164.960	40.000	36.000
Year	12.359	14.000	103.940	176.865	36.748	37.924

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for December. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	1940
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	23.50	20.50	22.50	21.00	23.00
March	21.50	23.50	20.50	22.50	21.00	23.00
April	21.50	23.50	20.50	22.50	21.00	23.00
May	21.50	23.50	20.50	22.50	21.00	23.00
June	21.50	23.50	20.50	22.50	21.00	23.00
July	21.50	23.50	20.50	22.50	21.00	23.00
August	21.50	23.50	20.50	22.50	21.00	23.00
September	22.50	23.50	21.50	22.50	22.00	23.00
October	23.50	23.50	22.50	22.50	23.00	23.00
November	23.50	23.50	22.50	22.50	23.00	23.00
December	23.50	23.50	22.50	22.50	23.00	23.00
Year	22.083	23.500	21.083	22.500	21.583	23.000

Iron, dollars per long ton. F.o b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

G. G. Sullivan, formerly of Ymir, B. C., has been appointed manager of the Homeward mine, at Zeballos, B. C.

R. W. Parsons has been appointed head of the South Australia School on Mines and Industries at Adelaide.

Joseph H. Taylor has been elected vice president of the Peru Mining Company, with headquarters at Deming, N. M.

Colin Yates has been appointed underground manager of Great Boulder Proprietary Gold Mines, Ltd., at Kalgoorlie, succeeding the late R. B. Ash.

H. A. Steane has returned to Ballarat, Victoria, from Cyprus, where he was on the staff of Cyprus Mines Corporation.

A. J. Hill has been appointed manager of New Milano, N. L., Mount Monger, Western Australia, in succession to **A. J. McGeorge.**

W. Lee Heidenreich is now at Potosi, Bolivia, where he is mine superintendent for Cia. Min. Unificada del Cerro de Potosi.

T. Platt, recently inspector of mining and machinery in Victoria, Australia, has been made inspector of mines for Tasmania.

G. A. Joslin, consulting mining engineer of Los Angeles, has been elected president of the Mining Association of the South West.

F. A. Hoffmann is in charge of the Williams tungsten mine, in Mohave County, Ariz., with headquarters at the Hotel Beale, Kingman, Ariz.

L. C. Karrick, mining engineer formerly with the U. S. Geological Survey, has been investigating Nevada mining districts.

Joseph R. Knowland, vice president, Kennedy Mining & Milling Company, has been elected president, succeeding the late Edward C. Hutchinson.

Alfred L. Ransome, geologist, California State Mining Bureau, has been appointed assistant mineral economist, U. S. Bureau of Mines, Washington, D. C.

J. Q. Blades, Western representative for the Ingersoll-Rand Company, has moved his headquarters from San Francisco to Reno.

R. L. Kidd has recently been at Placerville, Idaho, investigating the possibilities of treating the low-grade ores of the district.

Charles E. Newmeyer, veteran editor of the *Denver Mining Record*, has been on a vacation and visiting mining centers in Nevada and California.

M. B. Gentry, mining engineer who has been active in mining enterprises in both North and South America, has been elected a vice-president of the Freeport Sulphur Company. Mr. Gentry joined the Freeport organization in 1935 as assistant to the president, a position which he held at the time of his present appointment. He has been in charge of

M. B. GENTRY

foreign sulphur sales and of sales of the Cuban-American Manganese Corporation, Freeport's subsidiary which developed a new flotation process to concentrate low-grade Cuban manganese ores. The new Freeport vice-president was one of the men who developed the Anaconda Copper Mining Company's famous Chuquicamata copper mine in Chile, largest mine in the world today. Since his graduation from Sheffield Scientific School at Yale in 1906 and the Columbia School of Mines in 1909, he has spent a total of fifteen years in various mining undertakings in South America, the first a drilling campaign in Chile with William Braden in 1912. During the World War he was a captain in the U. S. Army Engineers.

Onne Marjama, of Ishpeming, Mich., has been made assistant superintendent of the Negaunee and Athens mines of the Cleveland-Cliffs Iron Company.

LeRoy Salsich, of Duluth, Minn., president of the Oliver Iron Mining Company, has been elected a vice-president of the A.I.M.E.

Guy C. Riddell has gone to California and Montana for inspection of mining developments under way with New York associates. His return to the East will be in latter part of January.

Andrew W. Newberry, consulting mining engineer, Springfield, Mass., is looking over the mineral resources of Tennessee and North Carolina, particularly manganese and tin.

Andrew T. Sweet, former head of the department of metallurgy at Michigan College of Mining and Technology, has accepted the position of senior metallurgist with the U. S. Bureau of Mines.

W. F. Boericke, chief valuation engineer, Bureau of Mines, Manila, P. I., left his post on Dec. 20 for a vacation in the United States. He will be in New York for the annual meeting of the A.I.M.E. in February.

Edward Morris, chief engineer of the Frontino Gold Mining Company, Segovia, Colombia, recently arrived in New York City, following a six-year contract with that company.

Fred M. Connell, president of Central Patricia (Ontario) Gold Mines, Ltd., has entered the Canadian Government service as an assistant in Canadian Metals Control, serving without compensation.

Robert W. Thomas, general manager of the Ray (Ariz.) division of Nevada Consolidated Copper Corporation, has been elected chairman of the Arizona section of the A.I.M.E., succeeding **Brent N. Rickard,** of Tucson.

E. A. Garber, manager of Northwest Magnesite, reports good progress in the construction of the company's 300-ton flotation plant to handle magnesium ore in Washington.

Henry P. Kervin, long engaged in the operation of mines and leases in Nevada, has been elected president of the Jumbo Extension Mining Company, with formerly productive gold property in the Goldfield district.

A. J. Klamt, mining engineer of 2335 Virginia Road, Los Angeles, Calif., is examining properties in Arizona and New Mexico. Temporary address is P. O. Box 148, Tucson, Ariz.

Jay P. Wood, consulting mining engineer of Denver, Colo., is back home after an absence of five months. He is associated with the firm of **Hamilton, Beauchamp & Woodworth,** metallurgical engineers, of San Francisco.

P. B. Nye, Government Geologist of Tasmania, who has been on loan to the Commonwealth Government for several years, as executive officer of the Northern Australia Survey, is to return to his duties in Tasmania in January.

P. E. Marmion, prominently associated with the Burma Corporation for several years, as general manager, managing director, and as vice chairman, has been appointed chairman in succession to the late Lord Horne.

S. R. Capps and **W. D. Johnson, Jr.,** have been assigned to survey manganese and chromium deposits in Brazil and **C. F. Parks, Jr.,** and **T. T. Theyer** will look for similar deposits in Cuba. Tin, tungsten, and antimony deposits in Bolivia will be studied by **J. F. McAlister** and **E. Callaghan.** All are geologists of the U. S. Geological Survey.

F. W. R. Godden, formerly general manager of Loloma (Fiji) Gold Mines, but latterly assistant general manager of Bulolo Gold Dredging, Ltd., Wau, New

Almost never before have the four production head men of the biggest mine corporations in the Coeur d'Alenes sat down together at a banquet of the Northwest Mining Association in Spokane, as they did Dec. 6 last. The occasion was the luncheon of Columbia Section of the American Institute of Mining and Metallurgical Engineers, which was addressed by B. H. Haffner, the recently appointed manager of the Bunker Hill & Sullivan Mining Company, who discussed the future of base metals. In the picture from left to right, are: L. E. Hanley, president and manager of Hecla Mining Company; Mr. Haffner; Bliss Moore, chairman of Columbia Section, standing; R. D. Leisk, manager of Sunshine Mining Company, and H. G. Washburn, manager of Federal Mining & Smelting Company, which has the Morning, Page, and Jack Waite mines

Guinea, has been appointed general manager of the latter company.

George McRella, formerly with the U. S. Bureau of Mines, now manager for the Lucre Hill Mining Company, has returned to the property in Mineral County, Nev., and to his Reno home from an extended business visit in New York City.

Dr. Nelson Horatio Darton, of Washington, D. C., was on Dec. 27 proclaimed by the Geological Society of America to be the leading geologist for 1940 and was awarded the Penrose Medal for distinguished research in pure geology and outstanding original achievements in geologic sciences. Dr. Darton has served for more than 50 years with the U. S. Geological Survey.

W. M. Tappan, general superintendent in the Hibbing Chisholm District for the Oliver Iron Mining Company, retired on Dec. 31, 1940, after 42 years of service. **H. S. Sherman,** who has been assistant to Mr. Tappan, will succeed him as general superintendent. **Albert St. Vincent** will be assistant to Mr. Sherman. Mr. St. Vincent was superintendent of Hull Rust Sellers Mine at Hibbing, Minn.

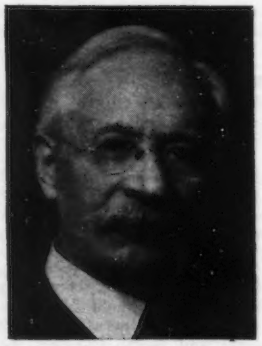
Walter S. Weeks, professor of mining, University of California, Berkeley, Calif., has been elected chairman of the San Francisco Section A.I.M.E. **H. W. Gould** is vice chairman, and **Gordon I. Gould,** secretary and treasurer. Members of the executive committee include **W. S. Boyd, H. C. Carlisle,** and **Charles White Merrill.**

Dr. Chris A. Hartnagel, who has long been associated with New York State both in the Education Department and as assistant geologist, was on Dec. 1 made State Geologist. While earning his master's degree at Columbia University in 1904 he became fellow in geology. After graduation in 1905 he entered the State Geologist's offices, where he has since served.

William Flatow, head of the ore department of W. R. Grace & Company, left for Chile early in January to set up an office to handle the details of sampling tin concentrate to be shipped to the United States for the account of the Metals Reserve Company, Washington. W. R. Grace & Company has been named agent to represent the Government's buying agency.

Ray L. Hallows, of Joplin, manager of the Galena smelter of the Eagle-Picher Mining & Smelting Company, has been awarded a patent by the United States patent office on a new process used in connection with the refining of lead. The award was made on the basis of fourteen new ideas, embracing two principal phases for the removal of copper from lead as a kettle dross and the recovery of the copper and the lead from the skimmings.

Dr. Charles P. Berkey, Newberry professor emeritus of geology in residence at Columbia University and consulting geologist in many of the largest civil engineering projects in the country, received honorary membership in the American Society of Civil Engineers on Jan. 15. The award is the highest honor bestowed by the Society.



DR. CHARLES P. BERKEY

H. W. C. Prommel, consulting geologist of Denver, recently inspected placer preparations centered on the Gold King mill grounds at Gladstone, Colo., in the San Juan district. The sampling covered a large area in the Cement Creek country, producing satisfactory results for large operations.

Robert Longyear has been at the Ruby Hill mines of the Eureka Corporation, Ltd., near Eureka, Nev., where the E. J. Longyear Company has drilled a hole over 1,200 ft. deep from the 900-ft. level of the Locan shaft of the Richmond-Eureka mine.

John D. Galloway, manager of Base Metals Mine at Field, B. C., has been appointed manager of the Jerome Gold Mines, at Sudbury, Ont. The Base Metals mine, operated by Mining Corporation of Canada, Ltd., which company also controls the Jerome mine, is operating to capacity, 300 tons per day, and will continue on this scale for at least another year.

Scott Turner, of New York City, has been selected by Henry L. Stimson, Secretary of War, to serve on a committee of seven engineers, representing various engineering groups, to assist the War Department in technical matters relating to the "collection, evaluation, and dissemination of information of value in the protection of civilians and vital civilian installations in time of war."

Herman C. Bellinger, vice president of operations of Chile Copper Company, Chile Exploration Company, and Chile Steamship Company has been placed on the retired list, after a long and distinguished career in mining and metallurgy. At recent meetings of the Chile Copper Company, Chile Exploration Company, and Andes Copper Mining Company subsidiaries of Anaconda Copper Mining Company, the following officers were elected: **Cornelius F. Kelley,** chairman of the board; **James R. Hobbins,** president; **William Wraith,** executive vice president; and **Burt Wheeler,** vice president in charge of operations.

▼ ▼ ▼

OBITUARY

Henry Bowman Douglas, a retired mining engineer of Newton, N. J., died on Nov. 14 at the age of 75.

Harry Allen, prominent in early mining in Idaho, died on Nov. 21 in Sierra Madre, Calif., at the age of 72.

George Kingsbury Fisher, a retired metallurgical engineer, died at Saranac Lake, N. Y., on Nov. 26. He was 75.

Major L. T. Burwash, a Canadian explorer of the North country and locator of the magnetic north pole, died recently at Cobourg, Ontario.

Frederick C. Alsdorf, well-known Los Angeles mining and metallurgical engineer, died recently in Los Angeles, Calif., aged 69.

W. H. Blackburn, consulting engineer, formerly manager of the Tybo, Nev., properties of Treadwell Yukon Corpora-

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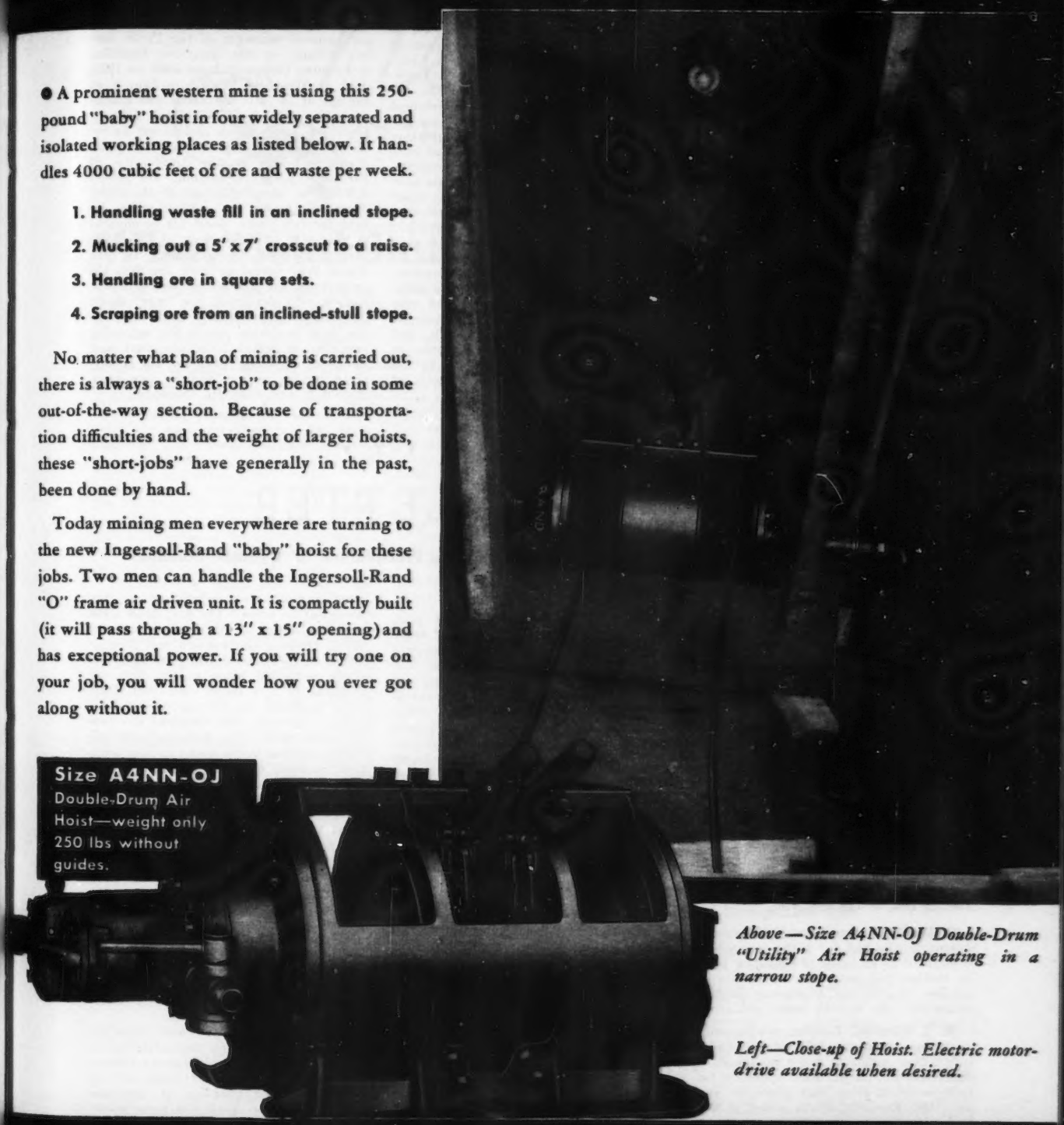

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AIR POWER *Aids* MAN POWER

tion, Ltd., died in Piedmont, Calif., on Nov. 28 at the age of 73.

John Cliffe Wilson, a director of Ohio Brass Company, and manager of its mining sales department, died at Mansfield (Ohio) General Hospital, Dec. 18, after a short illness. He had been identified with Ohio Brass for 35 years, and through that association became nationally known in the mining industry. Starting in the company's production department, he later became assistant office manager, and in 1912 head of the mining sales department. He was one of the organizers of the manufacturers' division of the American Mining Congress, and served as chairman of the board of governors on numerous occasions. He is survived by his wife and three children.

JOHN CLIFFE WILSON

Patrick M. Kinney, mine foreman of Braden Copper Company in Rancagua, Chile, died recently at the age of 34. He was a graduate of the Colorado School of Mines.

Marius Robison Campbell, geologist, and for many years on the staff of the U. S. Geological Survey, died in St. Petersburg, Fla., on Dec. 7. He was 82.

Areli C. Overpeck, 61, an Arizona mining engineer until recently living in Beverley Hills, Calif., died in Los Angeles on Nov. 21.

Stephen Birch, founder and chairman of the board of the Kennecott Copper Corporation and a director in many other important industrial and financial organizations, died in New York on Dec. 29 last, at the age of 68.

C. Henry Gordon, formerly a mining engineer, who had for many years been prominent as an actor of character parts in motion pictures, died in Hollywood on Dec. 3 after an emergency surgical operation. He was 56 years old.

M. J. (Scotty) Eunson, mining engineer and superintendent of the Caddo quicksilver mine, 20 miles northeast of Murfreesboro, Ark., was killed in an auto accident near that place on Dec. 10. Mr. Eunson's death ended a long and picturesque career in many parts of the world. He was 68.

E. J. Horwood, superintendent of mines in the Broken Hill Proprietary Company, Ltd., died in Melbourne on Nov. 14, aged 76 years. Mr. Horwood, who had held executive positions in the service of the company for a period of over 40 years, was prominently connected with the development of the flotation process in its earlier years at Broken Hill.

Randall P. Akins, widely known in the mining industry for his invention of the Akins classifier, died in Denver, Colo., on Oct. 25, 1940, after an illness of several months. Although denied the opportunity of obtaining a technical education, "Bill" Akins became an authority on the milling and concentration of ores, and his advice and counsel were sought by many mill superintendents. He joined the staff of the Colorado Iron Works Company in 1888 and was associated with that organization for the rest of his life—more than half a century—as construction superintendent, shop superintendent, and sales engineer. He had much to do with the development of the Colorado impact screen and other metallurgical equipment, and had also invented the Akins flotation machine. He was born in Nebraska City, Neb., and came to Denver with his parents at the age of ten. He is survived by his wife and married daughter, both of whom are residents of Denver.

Thomas B. Crowe, inventor and developer of metallurgical processes, and consulting engineer with the Merrill Company, of San Francisco, died at Palo Alto, California, on Nov. 13, at the age of 65.

Harry H. Alexander, metallurgist, and general manager of the Perth Amboy refinery of the American Smelting & Refining Company from 1908 to 1920, died at Westfield, N. J., on Jan. 5 at the age of 74. Mr. Alexander was graduated in 1888 from Virginia Military Institute, from which institution he received his M.S. degree, and did postgraduate work at the University of Virginia and at Columbia. He joined A.S.&R. as superintendent of its Globe plant at Denver, a position which he held for ten years, until his promotion to the post of supervisor of the company's Colorado department. In the World War period he built the first tin smelter in the United States at Perth Amboy. He developed the "wet" assay for lead, now universally used, and was the first to devise means for removing particles of metal from the dust and smoke of smelting furnaces. He is survived by his widow, and by two sons Harold F. and John H. Alexander.

▼ ▼ ▼

A LETTER

Effect of Deaeration on Precipitation of Cyanide Solutions

The Editor:

THE RAPID BUILD-UP of pressure in precipitation presses, sometimes experienced in gold-recovery mills, is generally attributed to two causes. The first and most usual one is faulty clarification and the second is the improper use of lead salts. There are cases, however, in which the clarified solution is perfectly clear and brilliant; yet slimy, difficultly filtered precipitates are obtained regardless of the quantity of lead salt fed, and where it is added, and irrespective of the cyanide strength and alkalinity of the solution.

Standard practice is to clarify, deaërate, add zinc dust, and precipitate. Deaëration preceding precipitation is, in all cases, recognized as a prerequisite of successful zinc-dust precipitation. However, the fact that we deaërate after clarification may be a general cause of trouble in the succeeding precipitation.

Every working cyanide solution contains varying amounts and kinds of dissolved impurities. Furthermore, these impurities may alter in quantity and character from time to time, depending on changes in the ore, mill make-up water, and other conditions. I believe that the removal of oxygen, carbon dioxide, and other dissolved gases from certain solutions may result in throwing down some of these impurities in the form of insoluble compounds which interfere with precipitation. These are probably compounds of calcium or sulphur.

If the solution contains impurities that go out of solution upon deaëration, double deaëration would be required to avoid rapid pressure build-up in the precipitation press. The first deaëration would be ahead of clarification and the second between clarification and precipitation, in the usual place. The lead salt would be added prior to the first deaëration, if it is found that lead itself forms insoluble compounds with the solution, otherwise, just ahead of the precipitation press. The deaërated solution is then pumped to the open clarifier tank. Any insoluble compounds thrown down in the first deaëration will be caught on the clarifier leaves and washed off with the ore slime. From this point we carry on with the usual clarification-precipitation process.

Two deaëration towers would be required and a pump for pumping from the first deaëration tower to the open clarifier tank. The second deaëration is necessary to remove the oxygen which may be picked up in the transfer of the solution to the clarifier tank and, in any case, vacuum must be applied to the system to suck the solution through the clarifier leaves if simultaneous clarification-precipitation is used.

Laboratory deaëration and filtration tests can be made on any solution to determine whether insolubles are thrown down when the dissolved gases are removed. As the quantity of insoluble would usually be small, the tests would need to be performed with large quantities of solution.

GEORGE F. REYNOLDS,
Mill Superintendent,
San Antonio Gold Mines Limited
Bissett, Manitoba

What Metal Statistics Show

PRODUCERS of base metals in the United States have been left with no doubt on what scale they should schedule production in 1941. Likewise, there is no doubt as to the government's desire to virtually stabilize prices for metals during the national emergency. Producers of copper, lead, and zinc, therefore, are expected to outline carefully the tonnages that can be safely exploited and made available for the national defense program, within the limits of prevailing metal prices.

Observers in Washington believe the 100,000 tons of copper to be imported from Latin American countries during 1941 in addition of the monthly domestic mine output of around 90,000 tons, will be sufficient supply for 1941 needs.

The duty-free copper statistics of the Copper Institute for 1940, in tons, follow:

	Production (a) Crude	Refined
January	89,598	80,501
February	76,145	82,761
March	85,796	86,295
April	84,366	80,964
May	82,682	86,029
June	79,845	86,077
July	79,327	90,995
August	79,967	80,851
September	78,238	82,843
October	86,911	83,076
November	(b) 84,283	96,283
December	84,937	97,035
Totals	992,095	1,033,710

	Deliveries to Customers: Domestic	Export	Totals
January	91,428	13,117	104,545
February	63,215	9,594	72,809
March	64,376	7,517	71,893
April	68,665	2,974	71,639
May	69,467	7,018	76,485
June	61,716	3,439	65,155
July	71,226	3,532	74,758
August	96,383	1,336	97,719
September	96,485	....	96,485
October	103,771	....	103,771
November	102,483	....	102,483
December	112,671	10	112,681
Totals	1,001,886	48,537	1,050,423

	(c) Refined Stocks End of Month
January	135,441
February	145,393
March	159,795
April	169,120
May	178,664
June	199,586
July	215,823
August	198,955
September	185,313
October	164,618
November	158,418
December	142,772

(a) Mine or smelter production or shipments, and custom intake including scrap. (b) Corrected. (c) At refineries, on consignment and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

▶LEAD—The latest statistics covering lead refined in the United States reveal that production and shipments during November were about in balance. Total production increased from 56,600 tons in October to 57,926 tons in November. More significant was the gain in output from domestic ore, from 39,228 tons in October to 45,089 tons in November, due largely to settlement of the labor dispute at Selby.

Many in the industry believe that total shipments—foreign refined and domestic refined metal — probably showed a gain, as foreign pig lead is being shipped to domestic consumers in increasing tonnages.

The domestic refined-lead statistics for October and November, in tons, according to the American Bureau of Metal Statistics, follow:

	Oct.	Nov.
Stock at beginning	41,292	35,386
Production:		
From domestic ore	39,228	45,089
Foreign and secondary	17,372	12,837
Totals	56,600	57,926
Domestic shipments	62,496	57,510
Stock at end	35,386	35,791

▶QUICKSILVER—Domestic production of quicksilver in November totaled 3,400 flasks. Production during eleven months in 1940 was 32,600 flasks, with domestic consumption at 25,000 for that period. Consumers and dealers' stocks at the end of November totaled 12,600 flasks, against 13,200 flasks a month previous, with producers' stocks at 979 flasks, against 855 on Oct. 31.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
1939	77.71	1940	79.22

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	77.23
March	72.41	77.09	77.94
April	71.19	74.79	77.19
May	69.15	73.61	77.68
June	67.55	73.17	78.85
July	72.95	71.95	76.72
August	73.94	73.88	76.71
September	74.70	83.07	79.40
October	77.61	84.25	82.49
November	78.36	83.80	83.14
December	77.13	82.89	82.42

▶ZINC—The November and December statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Nov.	Dec.
Stock at beginning	24,222	18,386
Production	56,459	59,883
Production, daily rate	1,883	1,932
Shipments	(a) 62,295	65,385
Stock at end	18,386	12,884
Unfilled orders	126,120	125,132

(a) Includes 560 tons exported.

Figures on operations of the Prime Western division alone, for the year 1940, in tons, follow:

	Production	Shipments	Stock At End
January	19,930	25,240	24,742
February	22,542	20,017	27,267
March	23,846	20,401	30,712
April	21,742	20,034	32,420
May	21,173	24,292	29,301
June	19,302	23,143	25,460
July	20,698	26,139	20,019
August	21,224	27,774	13,469
September	22,873	28,986	7,356
October	24,166	26,425	5,097
November	24,793	23,753	6,137
December	25,996	25,850	6,283
Totals	268,285	292,054	.....

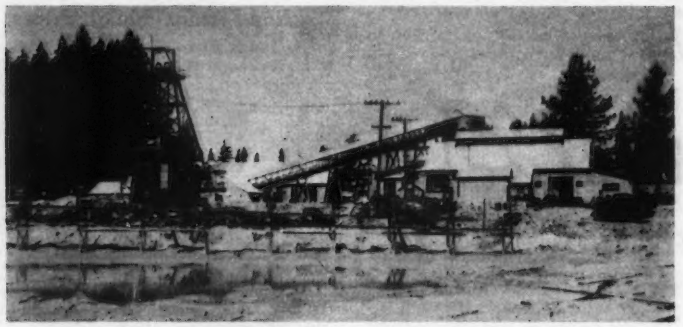
▶TUNGSTEN — Imports of tungsten ore for domestic consumption during October, according to the Bureau of Foreign and Domestic Commerce:

From:	Gross Weight Pounds	Tungsten Content Pounds	Value
Portugal	132,270	72,101	$61,632
Mexico	4,800	2,909	1,450
Bolivia	231,579	118,143	97,946
Peru	6,310	1,612	914
China	141,461	71,307	69,002
Thailand	4,132	2,061	1,874
Australia	45,854	25,540	21,551
South Africa	16,025	8,322	7,298
Totals	582,431	301,986	$261,667

United States Imports of Manganese Ore

Imports of manganese ore containing 35 per cent or more manganese, for domestic consumption, which includes ore withdrawn from bonded stocks, during October, according to the Bureau of Foreign and Domestic Commerce:

October Imports From:	Customs Districts	Gross Weight Pounds	Manganese Content Pounds	Value Dollars
U.S.S.R.	Pittsburgh	4,477,726	2,350,672	$34,284
Costa Rica	New York	2,258	913	10
Brazil	Maryland	41,744,192	18,529,885	222,309
	Mobile	5,840,537	2,891,650	12,511
	Pittsburgh	27,077,728	13,008,716	84,027
British India	Maryland	5,132,158	2,472,396	25,152
	Pittsburgh	24,557,792	12,483,762	164,936
	Philadelphia	8,255,835	4,225,419	55,196
Union of S. Africa	Tennessee	772,900	329,611	6,327
	Philadelphia	25,057	12,453	154
Gold Coast	Maryland	32,809,280	16,152,584	231,937
	Pittsburgh	14,267,771	6,935,182	115,988
	Philadelphia	4,743,200	2,707,453	66,107
Philippines	Philadelphia	106,822	58,752	925
Cuba	New Orleans	1,001,318	505,044	7,686
	Virginia	11,648,000	5,824,000	144,406
	New York	47,000	23,500	2,021
Totals		182,509,574	88,511,992	$1,173,976



Construction of a cyanide plant for treatment of concentrates has been undertaken at the property of the Golden Center Mining Company at Grass Valley, Nevada County, Calif. Above is a view of the Scotia shaft and the 150-ton flotation plant of the company.

CALIFORNIA

Production Resumed at Virgilia Mine

Concentrate shipments again under way following settlement of strike at Selby lead smelter—Fairchild Mining and Milling Company starts operation of new mill—Diltz gold mine being dewatered

▶ Production has been resumed at the Virgilia mine, near Virgilia, Plumas County, where work had been restricted to underground development because of the strike at the Selby smelter. Concentrates again are being shipped to the smelter, reopened a short while ago following settlement of the strike on Nov. 11. H. A. Cohen, of San Francisco, is manager, and C. H. Potter, superintendent, is in charge of operations at Virgilia.

▶ Milling operations have started at the property of Fairfield Mining & Milling Company near Weldon, Kern County, where a new 75-ton treatment plant was completed recently. Most of the ore is from the King mine, and an extra tonnage is expected from the Prosperity mine soon. Work is also being carried on at the Miranda holdings at Weldon and other claims in the Kernville area. Ralph Ralston, superintendent, is in charge of operations.

▶ Unwatering operations and general rehabilitation are in progress at the Diltz gold mine, near Mariposa, Mariposa County, which was subleased recently by Western Mining Association from E. R. Baker, one of the owners. Development includes a 600-ft. shaft, and a 15-stamp mill is available at the property. L. C. Gray, superintendent, directs operations.

▶ Underground work at the Harvard mine, near Jamestown, Tuolumne County, under lease to Alaska Juneau Gold Mining Company, P. R. Bradley, president, is being pushed vigorously, and good progress is being made in pilot raising the new shaft, to be known as No. 3, from the 500 and 300-ft. levels. Other development includes lateral work on various levels. Installation of a 500-ton milling plant is planned. P. R. Bradley, Jr., is in charge of operations, and about 46 men are employed.

▶ The new 100-ton recovery plant completed recently at the property of Panoche Quicksilver Mining Company, situated some 42 miles south of Hollister, San Benito County, has been placed in operation and is reported working satisfactorily. P. D. Burt, with offices in the Mills Building, San Francisco, is president and general manager, and about 15 men are employed at the mine.

▶ Placer operations, with bulldozer and carryall delivering gold-bearing gravel to the washing unit, are in progress at the property of Three S Mining Company, some 11 miles east of Weaverville, Trinity County. Virgil Hughes is general superintendent.

A.I.M.E. Will Convene for 154th Meeting

MEMBERS of the A.I.M.E. will gather for another important meeting to discuss events and progress in all branches of the mining field during Feb. 17 to 20, at the Engineering Societies Building, New York City. The most important theme of this occasion will be "The Mining Industry and Preparedness," the subject of an address by an outstanding speaker, scheduled for the get-together luncheon Monday, Feb. 17, at the Commodore Hotel.

Papers on the latest advances in mining and milling practise, health and safety in mines, mining geology, nonferrous metallurgy, and geophysics will be presented during the convention.

The annual banquet and reception will be held Wednesday, Feb. 19, at the Commodore Hotel. At this occasion H. G. Moulton, outgoing president, will turn over the gavel to John R. Suman, vice-president Humble Oil & Refining Company. Herman C. Bellinger will receive the William Lawrence Saunders medal for achievement in mining and the Anthony F. Lucas medal will be awarded to Conrad Schlumberger, posthumously, and his brother Marcel, for their development of the art of electrical coring or electrical logging.

▶ Production facilities have been increased at the McDow property, at Diamond Mountain, Lassen County, by installation of a larger grinding unit and a diesel power plant. The mine is operated by the Diamond Mountain Mining & Milling Company, controlled by George McDow, of Susanville; A. G. Lantz, of San Jose; and R. Fitzpatrick, of Petaluma. Operations are directed by R. S. Barthoff, superintendent.

▶ Mining operations are proceeding according to schedule at the Arctic mine, near Washington, Nevada County, recently taken over from L. F. Utter by the Kemmerer Exploration Company, a Utah concern. New equipment added to the surface plant includes a 60-ton mill and a 160-hp. Caterpillar diesel engine. Paul Jennings is superintendent.

▶ Horse Shoe Dredging Company, G. H. Butler, manager, has started dredging operations on the Gertzen ranch near Altaville, Calaveras County. The dragline dredging equipment in use was recently moved from Ione, Amador County, and reassembled at the present dredging site.

▶ A cyanide concentrate treatment plant has been completed and placed in operation at the Cherokee mine, near Greenville, Plumas County, operated by Alfred Merritt and associates. The new unit is designed to handle about 1½ tons of concentrates per day produced by the 200-ton flotation mill. Frank Humphrey, superintendent, directs operations.

ARIZONA

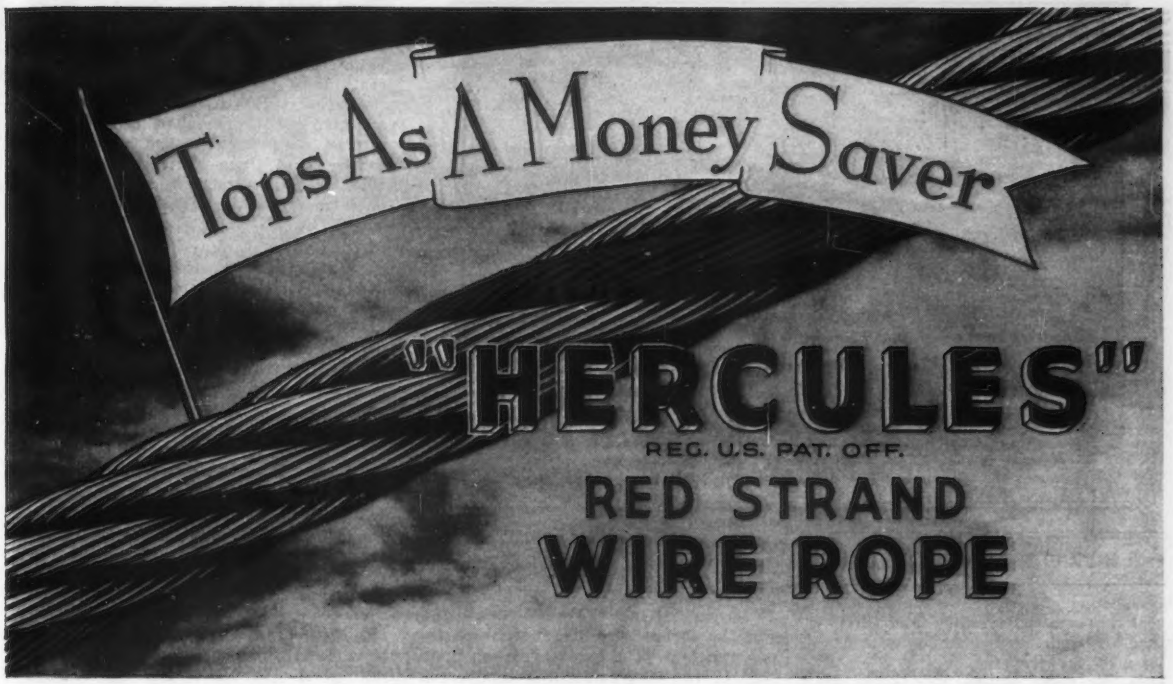
Molybdenum Deposit Being Developed

Property near the Mammoth-St. Anthony molybdenum mine expected to start production—Gold Cliff Central Mining Company starts treating ore from the Mexican mine

▶ Sam Houghton, of Mammoth, has leased the Querelli property, adjoining the Mammoth-St. Anthony ground at Tiger, and is developing the property with expectation to get into production soon. The property is reported to have ore similar to that of the Mammoth-St. Anthony mine which contains gold, silver, lead, and vanadium.

▶ The Gold Cliff Central Mining Company recently reopened the Mexican mine, near the Golconda group in the Cerbat Mountains. A crosscut tunnel has cut the vein at a depth of 100 ft. disclosing a substantial width of commercial ore. Bins have been built and ore from the mine is being treated at the company's mill located a mile away on the Oro Plata property. E. M. Leonard of Kingman is in charge of operations and R. E. Tabor of Los Angeles, Calif., is president of the company.

▶ A surface vein 7 ft. wide situated near the Vivian shaft at Oatman has been recently sampled showing values running better than $100 in gold per ton. Shipments are going forward to the Vivian custom mill. Insufficient work has



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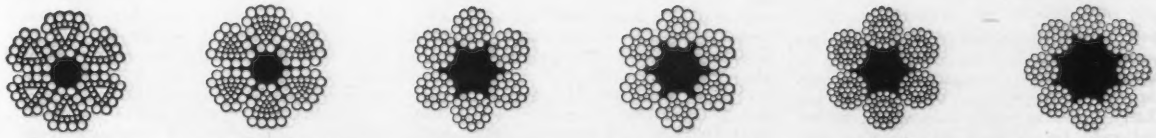

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A feature of the tailings dump at the Gold Road mine operated by the United States Smelting, Refining & Mining Company, at Gold Road, Ariz., is its terraced slope. The 300-ton counter-current cyanide plant is treating about 400 tons of material daily, including 100 tons of old tailings.

▶ARIZONA

been done, however, to determine its real importance. Hadley and Brooker made the discovery while working a lease on the property.

▶The shaft on the King of Secret Pass group of claims 20 miles west of Kingman is now down about 130 ft. and is reported in ore. The shaft will be sunk to 200 ft., when further exploration will be done along the vein. The property is owned by Walter M. Harrison, of Kingman. J. T. MacEvoy, of 50 Broadway, New York City, is president of the operating company. R. C. Ferguson, of Kingman, is in charge of the work.

▶A portable washing plant is being operated on the Pioneer Placer mines on Upper Lynx Creek northeast of Prescott, that is handling about 25 cu. yd. of gravel per hour. E. J. Schreck, of Prescott, one of the co-owners of the property, is in charge of operations.

▶A seventh carload of gold-silver ore has been shipped from the Bunker Hill claim, owned and operated by George W. Campbell of Salome. A new vein was recently opened which is producing a good tonnage of shipping ore. Other development work is under way in the old openings on the property.

▶At the South Sycamore group, 12 miles north of Clifton, siliceous gold ore is being mined by a small force of men in the newly opened workings of the Lady Franklin vein. A recent shipment returned better than $43 in gold and silver per ton. Harry C. White, of Clifton, is working the property under lease.

▶J. W. Bulkley of Salt Lake City, Utah, is working the Polaris mine, 10 miles north of Clifton, shipping of gold, silver, and copper ore.

▶The Oklahoma group, sometimes known as the Troxel mine, located in the Mineral Mountain district 12 miles east of Florence, has been optioned by Chicago interests. The erection of a mill is planned to treat the ore already developed.

▶The Samoa mine, near the crest of the Cerbat range 3 miles east of Chloride, and operated by the Brighter Days Mining Company, is being rapidly developed. Recently a long crosscut tunnel reached the Samoa vein at a distance of 1,678 ft., cutting the vein 700 ft. below the surface and 400 ft. beneath the old workings. The Samoa vein when cut was 12 ft. wide containing commercial ore across its entire face. The tunnel will be advanced 800 ft. to tap the Queen vein at a depth of nearly 1,000 ft. Three other veins are expected to be cut between the Samoa and the Queen veins, all of which have encouraging values at the surface. Under the operations of the present company, early indication points to the development of a promising property in the Chloride district. A power line has been erected to the mine. James F. Miller, of Chloride, is superintendent in charge of operations. George M. Mitchell, of 245 Market St., Paterson, N. J., is president.

▶A new Gould rotary furnace is handling about 50 tons of ore every 24 hours at the Pine Mountain quicksilver mine in the Mazatal Mountains south of Payson. A crew of 20 men are employed under the direction of Perry Taylor, general foreman. The general manager is Sampel Joseph, of Mesa.

▶Chicago interests have taken an option on the Grand Prize mine, about 30 miles east of Florence. Equipment is now being installed. John Pytlik is in charge.

▶Regular shipments of gold-copper ore are being made to the Hayden smelter from the Sunset mine, 20 miles northeast of Florence. New ore bins and a new headframe have recently been installed at the shaft, which has been deepened to the 200-ft. level. Drifting is now in progress on the vein. Present production is from the upper levels. Stanley A. Wardel, of Salt Lake City, president of the company, is at the property. Henry Currie, of Oakland, Calif., is in charge.

S.E.C. Simplifies Procedure For Exemption of Small Stock Issues

EFFECTIVE Dec. 9, 1940, the Securities and Exchange Commission announced a substantial revision of its procedure and rules in connection with the granting of exemptions under the Securities Act of 1933. The new regulations provide a single integrated exemption from registration requirements for security issues up to and including $100,000. Details can be obtained by asking the SEC for a copy of release No. 2416, which states in part:

"The new simplified procedure does not require the use of a prospectus in any case. To avail itself of the exemption, a domestic issuer will now need only to send to the nearest Regional Office a letter notifying that Office of its intention to sell, together with any selling literature it may plan to use. This letter of notification need contain only such information as the name of the company, the name of the underwriters, the name of the issue to be sold and a brief summary of the intended use of the proceeds. The issuer can give this notice, at its option, either through an informal letter or through the use of a two-page form which will be supplied on request for its convenience. Where the issuer chooses to use a prospectus, the regulation indicates certain skeleton information to be included.

"A broadened exemption is available in several important respects under the new regulation. For example, the Commission takes a new position as to future sales of the securities of the same issuer. Heretofore the Commission's rules have been such that, if the offering was a part of a larger financial program, involving the future sale of additional securities of the same class, the exemption was not available. The new regulation specifically states that the exemption is available even if 'it is contemplated that after the termination of the offering an offering of additional securities will be made.' This will apply in instances, among others, where issuers wish to make annual offerings of already outstanding securities for such purposes as employees' participation plans. In such instances, where the offering is not over $100,000, the exemption will be available.

"The new regulation shifts the Commission's administrative emphasis from the disclosure requirement of the Act to the fraud prevention provision. The examination procedure which has been followed in the past will be abandoned. The use of a prospectus is no longer required, although any selling literature which is employed must be forwarded to the appropriate Regional Office for its information. The new regulation will be administered from the Regional Offices under the usual supervision from Washington. It is hoped that the shifting of this activity to the Regional Offices will further simplify the problem of compliance with the Act by smaller issuers."

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NEWS FROM Washington

By Special Correspondent

ORGANIZATION for Defense is the latest Washington slogan. The Super Authority to speed production, headed by William S. Knudsen, promises to be something of a stimulus to more effective manufacturing. And Washington well appreciates the vital necessity for faster work. For a little while about mid-December it looked as though there was going to be alibi-sounding and attempt to pass the blame for delays to other agencies. But, very fortunately, recrimination did not get fashionable. There seems to have been so keen an appreciation of the urgency of action that even groups that are most unfriendly are not wasting too much effort exchanging brickbats. Instead, they are using the holiday period to send out "Hustle New Year's" greetings.

Fortunately, most of the raw-material problems seem to be fairly well on the way toward solution. Mineral supplies have been moving at an amazingly satisfactory rate. It is the manufacture of equipment of purely military types that has lagged badly.

Lending the Hose

OUR GOOD NEIGHBOR'S HOUSE is on fire. We should lend him our garden hose to help extinguish the blaze. When the fire is out a good neighbor would return the hose in good order or replace it with a new one. This was the essence of the President's parable when he told the press of his new plan for cooperation with the British on military supplies. And Washington fully expects that before 1941 is very old there will be authorized by Congress some sort of "full aid to Britain" program.

The major novelty in this program of handling of British assistance is that the United States should take the responsibility for all production within our borders without restricting by any immediate rule the quantity of munitions which we will deliver for use in the active combat for which Britain carries the full load. It assumes that we want everything that we could now produce, and that we shall want it after some sort of peace or armistice arrives. The "repayment in kind" plan, in fact, must presuppose that the United States will have to remain very fully armed with huge reserves of all munitions on hand instead of "on order."

Washington believes that this scheme has one great merit. It probably most easily permits many Congressmen to vote for more aid to Britain without too much loss of face. These men would have difficulty in voting for an outright repeal of restrictions on credits to belligerents or credits to defaulter nations. They do not have comparable embarrassment in voting to lend equipment or to lease it for a fee. The fact that we will probably not get back much of the equipment, may not want a great deal of it, need not be faced as a political issue just now. Only the more extreme isolationists must hold out against this program in order to maintain a normal attitude.

The mining and mineral industries may later (post-emergency) get involved if some aspect of barter or payment by raw material develops. But at the recent Holiday Season, when this was written, it did not appear that "lending the garden hose" is likely to extend to such raw materials as are of immediate concern to the miner. Those materials will be very fully processed into tanks, trucks, planes, explosives, and other finished commodities ready for battle before they leave the United States on lease.

More Export Licenses

ON DEC. 20 the President added fifteen commodities to the list of goods which can be exported only under license. Several chemicals, mainly those involved in manufacture of ethyl fluid for aviation gasoline, and three mineral commodities were on the list. The mineral commodities were strontium metals and alloys; cobalt; and abrasives and abrasive products containing emery, corundum, or garnet, as well as abrasive paper and cloth. The remainder of the list related to molding, measuring, gaging, testing, and similar equipment and to "tools incorporating industrial diamonds."

The executive order defined further these goods of mineral significance as follows: "A. Cobalt—(1) Cobalt metal. (2) Cobalt oxide. (3) Alloys and compounds containing cobalt in excess of 5 percent. B. Abrasives and Abrasive Products—(1) Wheels of emery, corundum, and garnet. (2) Grindstones of natural and of artificial abrasives. (3) Artificial abrasives, crude and in grains. (4) Abrasive paper and cloth. (5) Other natural and artificial abrasives, hone, whetstones, etc. H. Tools incorporating industrial diamonds—(1) Diamond dies. (2) Diamond drilling bits. (3) Diamond wheel dressers. (4) Diamond grinding wheels. (5) Diamond glass cutters and similar articles. (6) Diamond saws."

On Dec. 10 an earlier executive order placed similar requirement of license on exports of iron ore, pig iron, ferro-alloys, and almost the complete line of semi-finished and finished products of the iron and steel industries. This makes complete the Federal control of ferrous metals and the raw materials for their manufacture, so that our friends may be supplied but those less friendly can be prevented from access to our supplies.

On Jan. 10 the President issued a proclamation placing copper, brass and bronze, nickel, zinc and potash under export license control, effective Feb. 3. The President, Control Administrator Maxwell, and Defense Commissioner Church all insist this action was taken solely for the purpose of conserving supplies for the defense program.

Articles and materials included are:

1—Copper: Ore, concentrate, matte and unrefined, including blister, black, and coarse, converter, and anodes. Refined copper in bars, billets, cakes, ingots, slabs, and other commercial shapes. Old and scrap copper. Pipes and tubes. Plates and sheets. Rods. Wire, insulated and cable. Other primary fabrications. Fabrications for munitions purposes. Alloys, other than brass and bronze.

2—Brass and bronze: Scrap and old. Ingots and other commercial shapes. Bars and rods. Plates and sheets. Pipes and tubes. Wire, bare or insulated. Other primary fabrications. Fabrications for munitions purposes.

3—Zinc: Ore, concentrate, and dross. Cast in slabs, plates, or blocks. Rolled in sheets and strips. Other forms including scrap. Alloys. Dust. Manufactures containing 20 per cent or more zinc.

4—Nickel: Ores, concentrates, and matte. Metal in any form, including ingot, bars, rods, sheets, plates and scrap. Alloys containing 10 per cent or more nickel, including scrap. Nickel compounds (chemical) containing 10 per cent or more nickel.

5—Potash: Potassium salts and compounds, potassic fertilizer materials. All combinations and mixtures of potash containing 27 per cent or more of potassium oxide.

At the time of going to press it was not made known what restriction of exports will be applied under the proclamation. Exporters, apparently will obtain this information by applying for a license and see what happens. It is believed that restriction will be more rigid on fabricated products than on metal and restrictions on zinc will be more rigid than on copper.

A New Defense Philosophy

AT THE NEW YEAR the programming of defense manufacture accepts a new philosophy. Until lately the old Army idea had prevailed, that defense preparation would be superimposed on ordinary business. But the growth of the program makes continuance of that idea impossible in many cases. The Super-Board of defense, headed by Knudsen, therefore, is beginning to take raw materials to the extent that they are needed, even though this may temporarily deprive other enterprise of some of its normal supplies.

The Raw Materials Division of the Defense Commission, therefore, is faced with new responsibility. Mr. Stettinius and his staff must now produce raw material for these industry units which have been deprived of their supplies in order to give defense manufacturers adequate raw material. In some cases the new supply comes from expanded capacity of old industry. In some cases substitutions of novel or different raw materials may occur temporarily when that is easier than direct expansion of the primary mine, mill, or smelter. Some odd modification of demands on the mining industry may, therefore, be found in this project.

Incidentally, policing of industrial goods prices continues aggressively under the new program. The effort will be to prevent any start of those upward

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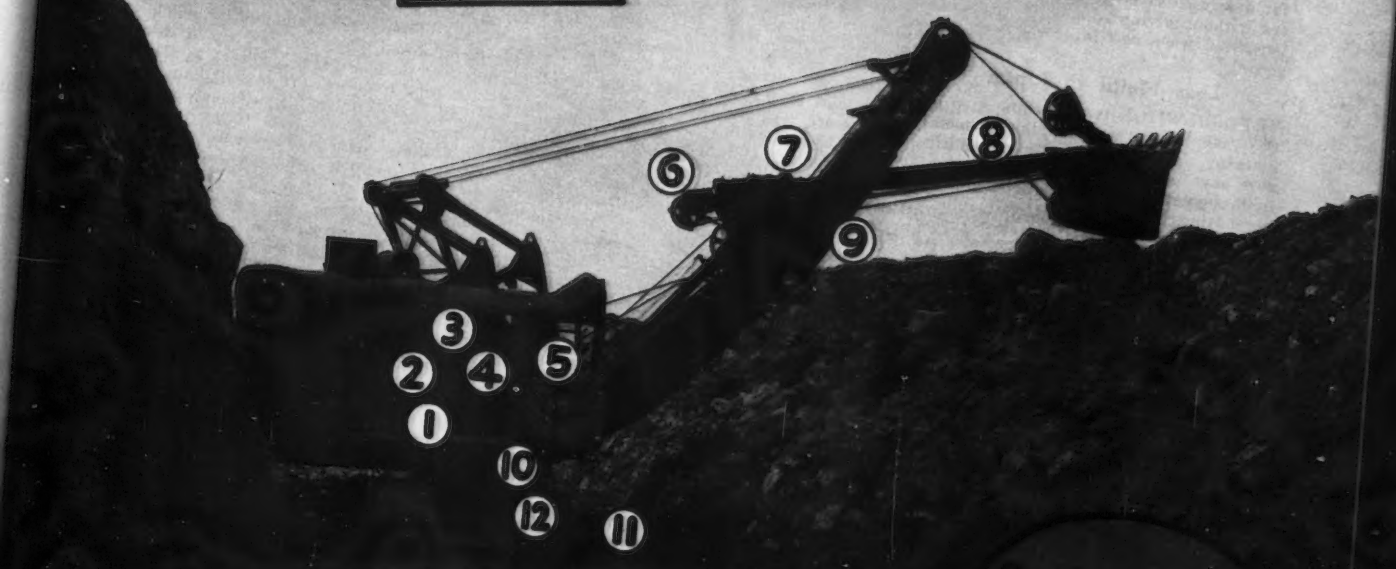

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spirals of prices which might otherwise come from temporary shortages or in periods of substitution. The inquiry by Leon Henderson into the recent price rise on fabricators brass products is one good example of the control being exercised.

New Labor "Standards"

PUTTING MECHANICAL PROCESS industry on more nearly continuous basis is one of the major problems that the Knudsen superboard is tackling. A temporary obstacle is the fact that double time for Saturday and Sunday work or work after midnight is met in certain labor contracts. There is much less difficulty in getting a sufficient number of workers for more shifts per week than there is in getting around these technicalities, which union men give up with reluctance. It is anticipated, however, that such labor "rights" will be surrendered if there is continued assurance of time-and-a-half for overtime beyond, say, forty hours.

The right to strike is another privilege of organized labor that is bound to become an area of controversy soon. In Washington there is a feeling that the public will not stand for strikes in defense industry. Congressmen hope that they will not have to vote on this issue. The effort is, therefore, to push negotiations in which labor will get the credit for temporarily surrendering this privilege and the government will get an assurance of uninterrupted operation of essential plants. Smart management negotiations in such cases are hunting for a way to save the face of the workers without giving some excessive compensation when new labor contracts are signed.

Less Metal to Japan

WASHINGTON is proceeding step by step to cut the supplies of metal reaching Japan. But sweeping embargoes have not been used, as they might in fact merely transfer Japanese metal purchasing to Latin American sellers. Only as full South American cooperation develops is it possible for Uncle Sam to cut off supplies of copper, lead, zinc, iron and steel, and other wanted military supplies.

Part of the buying program is being so managed as to insure the maximum cooperation in this strangling of the Nipponese military machine. The copper contracts described in the following were apparently so arranged as to make American purchases of wanted copper partly contingent on Chilean agreement to sell no more of the red metal to Japan.

Sooner or later the much-talked-of embargo on United States purchase of silk is going to become an active issue. But this will get official encouragement only when the Washington officials are convinced that such a drastic action is both diplomatically desirable and prospectively effective in breaking the morale of the Japanese people in their support of the military group. Long before that stage is reached it is expected that more drastic controls of American mineral export to the Orient will occur. However, all forecasting is hazardous because no one in Washington presumes to know how aggressively the southward march of the Japanese may be continued, or whether it can be forestalled.

Copper Purchases

CARRYING FORWARD the copper supply and price control program, described fully in these columns last month, the Metals Reserve Company announced on Dec. 19 its purchase of 100,000 tons of Latin American copper, as follows:

"From the Anaconda Copper Mining Company, 57,000 tons; from the American Metal Company, Ltd., 10,000 tons; from the Phelps Dodge Corporation, 5,000 tons; total, 72,000 tons, at 10¢ per pound, f.a.s. New York, on the condition that if at any time the cost of freight and insurance exceed ½¢ per pound, such excess will be borne by the Metals Reserve Company.

"The remaining 28,000 tons of copper was purchased from the Kennecott Copper Corporation at 9½¢ per pound, f.a.s. Chilean ports, on the condition that on such portion of this copper as the sellers can furnish transportation for, the Metals Reserve Company will allow sellers ½¢ per pound for transportation, war and marine insurance, making the total cost on such portion 10¢ per pound, f.a.s. New York. On such portion as the sellers are unable to furnish transportation for, the Metals Reserve Company will make its own arrangements for transportation at the best rates obtainable."

Tin Plans Lag

ALTHOUGH announcement of the location, financing, and operation of the proposed tin smelter has been imminent, and frequently promised, for the past two months, the details were still undisclosed early in January and remained so at the time of going to press. It can, however, be stated with reasonable assurance that all questions have been settled except that of location, and that the decision lies between Baltimore, Md., and Houston, Tex., with the odds shifting toward the former. Both the Army and RFC are believed to favor a Gulf Coast location, and remembering that Houston is Jesse Jones' home town, it may still win the prize. Mr. Jones, however, remains sphinx-like, and the final answer will not be known until he speaks.

Eight proposals for the tin smelter were originally under consideration, six from American firms and two from outside groups. The latter came from Patino, of Bolivia, for Williams Harvey, Liverpool; and Mr. Van den Broeck, of the Arnheim smelter, Holland. The American firms were Guggenheim Brothers, Phelps Dodge Corporation, American Metal Company, American Smelting & Refining Company, Hooker Electrochemical Company and Port Wentworth Development Corporation.

The Government is reported to favor plans for a permanent tin smelting industry after the present emergency is over. It is painfully recalled that both World War tin plants were out of business soon after the World War. Officials do not think it desirable that the United States make any present arrangement that would not give much longer life to new construction financed by the government in the present emergency. Domestic bidders are believed to share this idea, but the two foreign interests are not so happy at the thought that there would be permanent competition in the United States with other British and Dutch smelter properties.

News "Fines"

Fewer Strategics—The list of strategic materials approved by the Army and Navy Munitions Board in January, 1940, included fourteen commodities. Three of these commodities now could be removed from the list, though it happens they still remain on it. These commodities are cocoanut shell char, mercury, and tungsten. The government is buying an abundance of activated charcoal made from domestic raw material. And no less an authority than the director of the U. S. Geological Survey says that this country is now substantially self-sufficient with respect to mercury and tungsten.

Enough Aluminum—Complaints that there was not enough aluminum to supply aircraft factories have not proved true on Washington investigation. Some plane builders have expanded so fast that they themselves have failed to order adequate supplies. Others experiencing shortages of special forgings have blamed the light metal makers rather than the limited forging capacity of the fabricating plants. These examples well illustrate the confusion which comes from any effort to alibi about delays in manufacturing. Few of these have come from any actual shortages of mineral raw material.

Mine Safety Effort—The Department of Interior and the Bureau of Mines executives are taking every opportunity to stress the necessity for greater Federal control over the mining industry. Each mine disaster is used as a sounding board for further appeals in support of the mine inspection bill, which initially would give the Secretary of the Interior greatly extended powers in the coal mining industry. It is well known that the plans of the Department contemplate extension of that authority to metal mining, if they can once get a toehold by simpler legislation covering only coal.

More Metal Capacity—The Defense Commission has emphasized its first successful effort to encourage building and operation of more iron and steel capacity. Equally important, in the minds of the Defense group, is the expansion of facilities for processing zinc ore. Comparable effort in expansion of copper mining or smelting is not wanted, apparently. Very quietly, but still effectively, other expansion programs have gone forward to insure more adequate supplies of quicksilver, tungsten, vanadium, and other near-strategics.

Priority Rules—The plan for priority control of any commodity not available in quantity to supply both civilian and military requirements is a very simple one. The military orders will carry expected dates of delivery on primary contracts. Subcontracts for material can (by Army or Navy approval) carry similar delivery "requests." Voluntary acceptance of those dates as binding has been almost universal thus far. Thus, there are no "orders." But the requests for given dates on given deliveries are being met, and other folks simply step back a little in the priority line when necessary.

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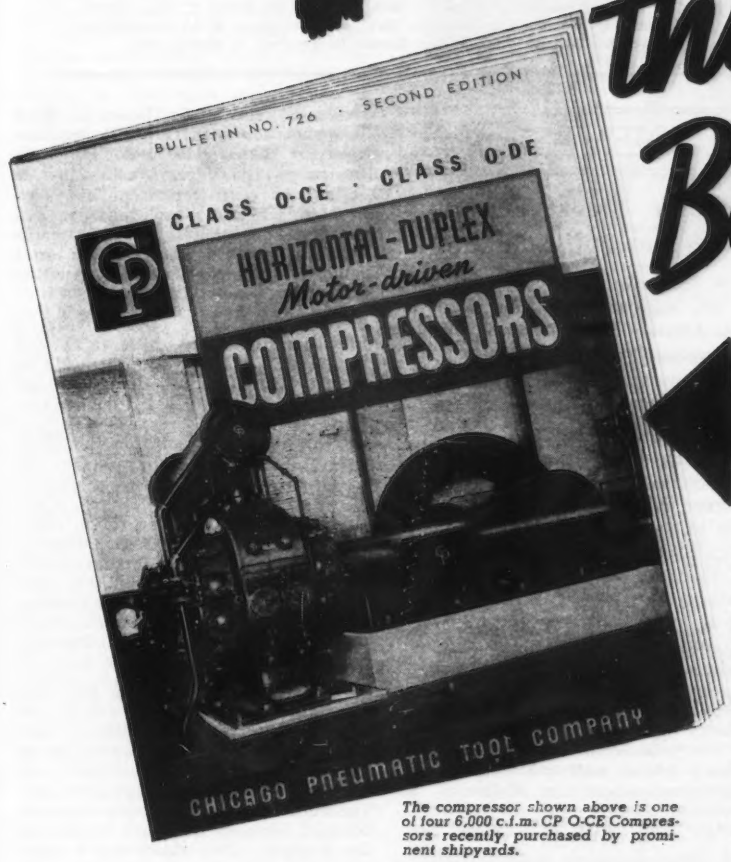

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NEVADA

Bottle Creek Mercury District Being Studied

U. S. Bureau of Mines mapping geology of this important quicksilver area—Nevada Keystone Mining Company planning construction of a flotation plant

▶Mapping of geology, together with some prospect work, is being conducted by engineers of the U. S. Geological Survey in the Bottle Creek cinnabar district in Humboldt County, now Nevada's foremost mercury-producing area. Greenan Quicksilver, Inc., operating the Blue Can mine and 50-ton rotary furnace, has entered into a contract with the Fisher Research Laboratory, of Palo Alto, Calif., for a geophysical survey of the district.

▶A flotation plant designed to treat 1,000 tons per day of tailing from the 350-ton scheelite mill of the Nevada-Massachusetts Company near Mill City, Pershing County, is reported nearing capacity operation. The company, largest U.S. producer of tungsten, has completed a 100-ton mill at a unique tungsten-bearing deposit at Golconda, in Humboldt County. Ott F. Heiser is manager, with offices at Lovelock, Nev.

▶In the Gold Circle district, western Elko County, the cyanide mill of the Esmeralda Gold Mines, Ltd., is treating 35 tons of gold-silver ore per day, chiefly the product of development work. C. Tracy is superintendent at Midas, Nev., and W. F. Wilson, 255 Bay St., Toronto, Ont., is president.

▶A statement by Congressman James G. Scrugham, of Nevada, said that the Metals Reserve Corporation would shortly award a contract for construction of a 400-ton mill designed to concentrate low-grade manganese ore in the Vegas Wash area, 10 miles north of Boulder dam. Some manganese was produced from deposits at this point during the World War, and prospecting has been conducted recently by Harlan H. Bradt in association with G. R. Boggs, manager for the Boulder Dam Manganese Company. The Vegas Wash plant, described as a flotation-nodulizing concentrating mill, has no connection with the processing plant to be built shortly as a department of the U. S. Bureau of Mines electro-metallurgical experiment station at Boulder City.

▶After a period of over 20 years in which its property has been worked only by lessees, the Jumbo Extension Mining Company, of Goldfield, following laboratory and spectographic tests of famatinite showing the presence of 1 to 3 percent tin in ore seams on the 790-ft. level of the Velvet shaft workings, has levied an assessment with the purpose of prospecting deeper, at the shale-alaskite contact, both for tin in recoverable quantity and for the extension of gold orebodies that produced over $2,000,000 around 1913. Henry P. Kervin is president and Ben Gill secretary-treasurer, in general charge of company affairs, with office at 321 Lyon Building, Reno, Nev.

▶The Combination shaft on the Comstock lode at Virginia City, deepest vertical shaft in Nevada at 3,262 ft., with three compartments and manway, is being reconditioned to the 1,700-ft., or Sutro tunnel, level to explore new areas. The work is conducted by the Comstock Tunnel & Drainage Company, which owns the property. The shaft was a joint project in which several of the old bonanza companies united, but it proved an economic failure. James M. Leonard, of Virginia City, is manager.

▶Consolidated Coppermines Corporation, operating the Emma Nevada and adjacent copper mines at Kimberly, White Pine County, on Dec. 23 paid an extra dividend of 20c., making a total of 50c. per share for 1940. October net income of $220,000 was largest in the company's history and costs were lowest. Ore shipments to the Kennecott smelter (Nevada Consolidated Copper Corporation at McGill) are at the rate of 9,000 tons per day.

▶Gold-silver-lead ore is being shipped

to a smelter in Utah from the Keystone mine of the Nevada Keystone Mining Company in the Central district, northern Pershing County, where early construction of a flotation mill is planned. Raymond Brooks is consulting engineer and in charge at the Keystone mine.

UTAH

Elton Tunnel Has About 4,000 Ft. To Go.

Completion expected in second quarter of 1941—New Park Mining Company developing its new orebody—Tungsten concentrator to be built near Milford

▶ Prediction that the Elton Tunnel of the National Tunnel & Mines Company at Tooele will be completed in four months, recent developments at the New Park Mining Company property, and reports of discoveries of tungsten in Beaver County mines and even of tin in Emery County brought a more optimistic color to Utah mining activities of early February. Utah's longest and largest mining tunnel now, it is reported, has reached a length of 21,000 ft. with the completion mark hardly 4,000 ft. distant. Near the 20,000-ft. point, solid limestone requiring no timbering was entered, so that progress is now at the rate of 40 ft. daily. Water flow measures 3,500 g.p.m. The 4.5-mile tunnel, 12 ft. high and 11 ft. wide, will be used to drain the lower levels of National Tunnel & Mines properties in Bingham, consisting mainly of the Utah Apex, and transport miners from Tooele to work. Near the 4.5-mile mark, a raise will be put up to connect with a drift from the 2,400 level of the Rood shaft of the Utah Apex.

▶ Western operations in the Mayflower tunnel of the New Park Mining Company are following three feet of ore in the Park Galena fissure, reports W. H. H. Cranmer, president and general manager. This development, it is said, indicates a new orebody west of the 1,000-ft. oreshoot, corresponding to the pattern of deposition in the upper levels.

▶ The demand for war minerals has speeded the search for tungsten in the Star and Beaver Lake district mines near Milford. The prosper Mining Company, operating the Harrington-Hickory property for copper, reports the discovery of scheelite. Edward Schoo, president and general manager, announces that a 30-ton milling plant will be erected to concentrate the ore. The Prosper company has shipped 76 carloads of ore since last February. Scheelite discoveries have been reported by the Tintic Lead Company, operating the Copper Ranch claims, and by the Magnolia Lead Company on several of its groups of claims.

▶ A. G. Riach and Ernest Derwent are investigating the possibilities of tin production from deposits in the Cedar Mountains, 10 miles east of Huntington, Emery County.

▶ The Tintic Standard Mining Company, which recently acquired an interest in

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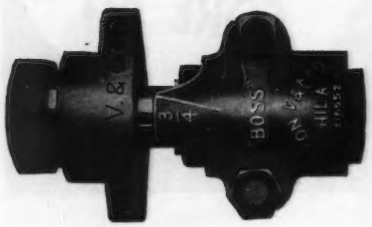

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▶UTAH

the East Park City property, has had its engineers and geologists examine the property to assist in planning a development program for the mines. George Heikes, of the National Lead Company, has completed a report on the mine, which, it is said, will be used in making a decision as to whether to extend a Union Pacific Railroad spur two miles to the Mayflower tunnel from the Keetley branch line.

▶A development crew, directed by Tom P. Costas, is cleaning out the Gold Queen mine tunnel at the western end of the property preparatory to exploring three fissures showing copper-gold values on the surface.

Wage-Hour Hearing on Mine Worker's Day

Western mine operators and Union Officials expected to submit brief of the evidence and arguments early in February on definition of "collar-to-collar" underground working day

MINE OPERATORS and representatives of labor unions gathered at Salt Lake City on Dec. 18 for a fact-finding conference on what should constitute a day's labor in underground non-ferrous metal mines. The hearing, held under the auspices of the U. S. Department of Labor, was attended by representative mining operators from at least nine states—Utah, Montana, California, Idaho, Nevada, Arizona, Washington, Wyoming, and South Dakota. Harold Stein, assistant director of the hearings branch of the wage-hour division of the Labor Department, Washington, D. C., presided. He was assisted by Kenneth C. Robertson, senior attorney, solicitor's department of the Labor Department, Washington, D. C.

Evidence submitted either supported or attacked the definition of an underground worker's day as consisting of eight hours on the "collar-to-collar" basis.

D. M. Kelly, vice-president and general manager for Anaconda Copper Mining Company, declared that the eight hour collar-to-collar shift would increase competition to the detriment of his organization. "I doubt if we could operate at all under such a definition of the worker's day," he said. Citing statistics to support this statement, Mr. Kelly said that Anaconda's net income from Montana operations during 1937, the best year since 1929, was $1,642,093. If the eight-hour collar-to-collar shift had been in effect, the company would have shown a loss of $1,221,000 for the year, he said.

J. J. Carrigan, Anaconda manager of mines in Montana and Wyoming, testified that the loss in production at Butte mines would be 9.83 percent, or 2,270,000 pounds of copper monthly based on present production, an annual loss of $2,863,000 per year.

Mr. Kelly added that the collar-to-collar shift would mean a decrease, not an increase in employment. All normal producing mines are now operating, he said. Marginal mines cannot be operated on 12c. copper.

A change to the collar-to-collar shift would seriously affect the contract now held to supply the government with manganese, Mr. Kelly said. Miners, under the present system of having underground workers transported to their working places on company time, and eating their lunch and being hoisted from the mine on their own time, now put in only seven hours of productive labor. The collar-to-collar eight hour shift would reduce productive time to six hours. The State of Utah, it was explained, has a statute requiring an eight-hour collar-to-collar shift; in Montana the shift is eight and a half hours.

Mr. Kelly also stated that the labor cost in Butte mines represented 40 to 48 percent of production expense, and in large open-pit mines the labor costs were as low as 10 percent. Butte mines pump three tons of water for every ton of ore produced, he said.

A. G. Mackenzie, executive secretary of the American Mining Congress, Utah Chapter, who closed the testimony for operators, stated that "no flat rule would be equitable for all mines, so variable are physical conditions. Any reduction in working hours must come out of productive time. The only time that counts is that spent at the face drilling. Conditions in Utah are comparable with conditions in other underground mines over the country."

In support of underground workers' demand for the eight-hour collar-to-collar shift, Reid Robinson, president of the Internation Union of Mine, Mill and Smelter Workers, Denver, Colo., declared that "production from underground metal mines has increased, while employment has declined 50 percent in the last 25 years." Mr. Robinson argued that metal-mining companies should be obliged to pay underground workers for all the time spent under company supervision. Mr. Robinson and other workers' representatives contend that the Butte shift is as long as an hour over the eight-hour day. He claimed that it was his organization's desire to bring about a standard working-day practice to increase employment and to provide the same basis of competition for all companies.

Lee Pressman, Washington, D. C., counsel for the CIO, who handled the presentation of the union's evidence, stated that the underground miner's day began when he checked in after getting into his working clothes and ended when he changed from working to street clothes at the end of the shift. While this was the goal, the union is only striving to secure eight-hour collar-to-collar contracts with mining companies.

Glen Zorn, representing Butte miners, testified that the working day at the Montana camp was often nearly nine hours long. Lawrence G. Robison, representing Bingham, Utah, underground workers, estimated that the average shift in Utah underground mines is seven hours at the face.

William M. Knerr, chairman of the Utah State Industrial Commission, announced after the conference that he is asking Col. Philip B. Fleming, national wage and hour administrator, to call a hearing in Salt Lake City relative to the status of leasers as employees of mining companies under the wage-hour law.

Representatives of both sides were given until Feb. 1 to submit briefs of their evidence and arguments. A similar hearing was held at Birmingham, Ala., by the Labor Department relative to wage-hour conditions in iron mines, on Jan. 14.

IDAHO

Large Zinc Deposit Being Developed by Anaconda

Shipments being made from property in Owyhee County—Larger gold placer operations planned for 1941—Sherman Lead Company gradually increasing output.

▶ The Anaconda Copper Mining Company, operating through a subsidiary corporation, has started mining operations in Owyhee County on South Mountain on what is reported to be one of the largest zinc deposits in the United States. The vein is said to be 168 ft. wide at the lowest point opened and portions will run as high as 70 percent zinc. Trucks are hauling 40 tons daily to Marsing station for shipment to Tacoma smelter. The state line between Idaho and Oregon runs through the deposit and each State is contributing to road construction work. Twenty-five men are employed at the property.

▶ Large-scale hydraulic operations will soon get under way at the Gold Hill placer near Idaho City, recently purchased by A. F. Baumhoff, of Centerville, Ole Johnson, and Lewis W. Mann from W. W. Miller and Franklin Trust Company of Pennsylvania.

▶ The Sherman Lead Mining Company's new 300-ton mill at the mouth of the Hercules tunnel in Burke is now turning out lead-silver concentrates at about 50 percent of its rated 300-ton capacity. Full capacity will be attained as soon as more machinery is installed. About 75 men are employed in mine and mill operations on a 24-hour basis.

▶ The Bradley interests, of San Francisco, are developing some 200 mining claims near Stibnite in the Yellow Pine district containing deposits of gold, silver, and antimony. Worthen Bradley, of San Francisco, is president of the company and Lloyd C. White, general manager at the mines.

▶ Golconda Lead Mines Company, Coeur d'Alene district, is making preparations to resume mining operations on its May-

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flower lead-zinc vein, which was opened several years but no production made during low market prices. The ore body is said to be 9 ft. wide where intersected and averages 4 ft. in width for some distance. Golconda's 250-ton milling plant is operating at capacity on its own and custom ores.

▶Beaver-Tungsten Gold Mining Company has been organized by J. D. Chapen and associates to operate the old Kennan gold property in the Beaver Creek district between Wallace and Murray. About $10,000 has been expended on new buildings, ore bins and a 100-ton flotation plant. Mr. Chapen reports the vein 12 ft. wide averages about $14. The company is also prospecting a tungsten vein.

▶General Electric will erect a small pilot mill on the Miller tungsten property near Patterson, it is reported. Development work has been under way for a year in charge of Mr. Barrows, of Salt Lake City, who is also general manager of General Electric's Germania tungsten mine, in Washington.

▶Western Gold Exploration Company will install a 50-ton cyanide milling plant on the company's No. 1 Valley mine in the Yankee Fork district of Custer county. Diesel power will be used. About ten men are employed. Frank H. Gunnell, of Salt Lake, is vice president and general manager.

OREGON

Copper Mine Being Rehabilitated

Property in Baker County also to be exploited for silver—Quicksilver mining continues active

▶The U. S. Metals Company, which is reopening the old Bayhorse mine, 10 miles north of Huntington, near the Snake River, reports that in clearing out the tunnel values of $6 to the ton in copper and $40 in silver have been secured from a wide vein. John L. Magney, mining engineer, reports an ore body 300 ft. long.

▶Quicksilver Syndicate has been treating about 75 tons of ore a day at its property near Blackbutte. The operations have continued about six years, with Frank Taylor, president and manager. There are six miles of underground workings.

▶Consuelo-Oregon Mining Company worked out its ground early during the summer on Cracker Creek near Sumpter and has moved its dragline to McCully's Fork in the same vicinity.

▶Paramount Quicksilver Mines, Inc., has been formed at Baker, Oregon, by Walter C. Fellows, Milton Reichert, and Donald Kempier.

▶Bruce Dennis, of Portland, last summer rebuilt the 35-ton flotation mill destroyed by fire a year ago at the Buffalo mine, near Granite.

WASHINGTON

Knob Hill Mines Begins Operations of New Plant

Refractory sulphide gold ores are being treated—Deertrail Monitor Mines Company developing promising molybdenum deposit —Plant being built to treat nickel ores

▶Knob Hill Mines, Inc., of San Francisco, has put into operation a plant treating 30 tons of refractory sulphide gold ores daily at its property at Republic. The plant includes six 56x14-in. new-style Fagergren flotation machines with motors, and one 20x8-ft. Wemco heavy-duty thickener with 2-in. diaphragm pump and a 6-ft. 8-leaf filter. F. H. Mitchell is general manager.

▶Seventeen months of operation by the Methow Gold Corporation, at Twisp, produced ore shipments that returned $341,478 to November 30. H. Mahlon McCain, of Spokane, is president.

▶Forty-three carloads of concentrates were shipped from the Metaline district in November. The shipment included 40 cars of zinc concentrates and three of lead.

▶Deertrail Monitor Mines Company reports finding 9 ft. of good grade molybdenite ore in its first day's crosscutting at the bottom of its shaft which has been completed to a depth of 110 ft. at its property west of Chewelah, in Stevens County. The company is milling ore from the level 50 ft. above, the ore carrying ½ percent molybdenum.

▶Washington State Planning Council, at a meeting in Pullman in November, inspected the laboratories and plant which United States Bureau of Mines is using at Washington State College to perfect a process for producing magnesium. H. A. Doerner, of the Bureau of Mines, was sent to Pullman four years ago and has been in charge of the work.

▶J. B. Fink, director of the State Department of Conservation and Development, says the cheap power which has been developed by the Bonneville and Grand Coulee dams can be used to develop an iron and steel industry somewhere on the north Pacific Coast. His survey shows that not less than 875,000 tons of iron ore has been exposed in the State. Substantial quantities of hematite and magnetite are mined in Stevens and Okanogan counties and used in the plant of the Northwest Magnesite Company at Chewelah.

▶Pacific Nickel Company is building a 150-ton mill at Mount Vernon to handle nickel ore from its property, four miles from that town. James G. Smith is president.

▶Admiral Mining Company, which has property near Valley, Stevens County, has also acquired 400 acres close to the Canadian border. J. Richard Brown, mining engineer, reports a strike in this property, in an open cut 6 ft. deep.

ALASKA

Many Small Miners Report Successful Year

Numerous hydraulicking operations contribute to 1940 gold output—Antimony production greatly increased in Kantishna district

▶ From many districts come reports that 1940 was the best year for mining in Alaska's history. Seward Peninsula probably had its best season, with many camps active. Hydraulicking has been successful, as conducted by George Bodis, on Dick creek; Emil Laurin, on Macklin creek; George Waldhelm and associates on Lower Kougarok; John Kanari, on Upper Kougarok, and Maurice Kelliher, in a new camp on Upper Kougarok. Castelton & Keenan have been employing 50 men hydraulicking and dredging on Trinity and Kougarok; 15 men have been employed hydraulicking on the Gold Bullion, and 12 on the Alaska Taylor property on Kougarok. Giant Mining Company employed 10 men at its hydraulic camp on Coffee creek. Graham Lammers has been operating a dredge on Kougarok. Carl Anderson opened a new operation on Macklin creek, and Botis, Bale and Peters, a new project on Schlitz creek. There has been extensive prospecting in the district. Manley Hot Springs district produced placer gold and tin, valued at $514,000, in spite of low water. This production is the greatest in many years for that district. J. R. Frank & Company had a good year on Pioneer creek, and Sullivan, Tofty and Deep Creek operators worked throughout the season. Cleary Hill Mines Company was an extensive operator on Sullivan and Tofty creeks and has acquired ground in the Eureka creek section for 1941 operations.

▶ Preliminary estimates by the United States Geological Survey of gold production in Alaska in 1940 show the greatest value in history at $25,375,000 or nearly $2,100,000 more than in 1939. Platinum output was estimated at 28,860 oz. Production of mercury, antimony, and tin increased, whereas lead and copper declined.

▶ The mine of Maurice P. Kirk and son, in the Kantishna district, had a production of approximately 700 tons of antimony ore in 1940, according to Earl R. Pilgrim, manager. This is twice the output of the previous year.

▶ A new gold camp which may prove to be one of the most northern mining districts in the world is reported east of Point Barrow, so close to the Canadian border that it may extend into Yukon Territory. O. B. Morris, trading post man, reports that a prospector brought in a poke containing 50 ounces of gold from this new discovery.

▶ Miners in the Fortymile district and in the area around Bluff, in the lower Yukon country, and on Mammoth Creek in the Circle district, report profits heavier than in the average season.

▶ Alaska Juneau Gold Mining Company reports a net operating profit for the

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▶ALASKA

first ten months of the year at $1,019,600, compared to $1,103,300 for the same period in 1939. Charles Holt and associates have done successful work and expect to put in two drag lines in the spring in the Clearwater district.

▶E. M. Ehrhardt, of Spokane, and associates, have formed the Kensington Mines Corporation for the purchase of patented and unpatented mineral claims held by Amos Bliss Trites in the Berners Bay section of the Juneau district. Mr. Ehrhardt has resigned the presidency of the Federal Land Bank at Spokane to enter the mining business.

COLORADO

Custom Mill at Crisman Near Production Stage

Preliminary tests involving roasting of some ores in the Boulder district—About 7,000 ft. remain to be driven in the Carlton Tunnel

▶The new Eureka custom mill at Crisman, in the Boulder section, is being made ready for operation, as the preliminary tests of the past several weeks have been entirely satisfactory. Tests showed finer grinding necessary before roasting. The plant has a capacity of approximately a ton an hour and is accessible to the ore supply in the district. The mill was built by D. W. Schmitt, of Boulder, and it was the first of its type. The roaster is of a muffle type in which the fire and the ore are in separate chambers. Ore passing through the various compartments is oxidized, liberating the metal and preparing it for separation of the gold and silver as bullion. The Schmitt roaster was built at the Hainke Foundry and Machine Company, Kensington, Kan.

▶The 25,000-ft. mark in the new Carlton drainage tunnel in the Cripple Creek district has been passed; and this leaves approximately 3,000 ft. yet to drive before completion of the tunnel, to a point under the No. 2 shaft of the Portland mine on Battle Mountain. At the present rate of progress the remaining 7,000 ft. of the main bore will have been completed by April, 1941. All records for tunnel driving have been shattered in this Carlton work. The first heavy flow of water to be opened was cut the last of November in a northwest southeast fracture.

▶H. A. Horn has a number of trucks hauling dump ore from the Saratoga mine, in the upper Russell Gulch district, to Blackhawk, and shipments are made from here to the Golden Cycle mill at Colorado Springs. C. W. Savery is president of the Colorado Silver Company.

▶Fire, started by the explosion of a gasoline torch, recently destroyed the Butterfly mill at Ophir. A new mill will be constructed as soon as possible. Max E. Binner is secretary of the company.

▶Rico Argentine Mining Company, at Rico, and which stock is largely owned by Salt Lake capital, declared a 1c per share disbursement paid Dec. 21 last. J. C. Johnson is president and W. G. Seley secretary.

▶Due to heavy snowfall, the Treasure Mountain Gold Mining Company has been forced to stop ore shipments from its Golden Fleece mine, on Treasure Mountain, 14 miles from Ouray. Operations will be resumed in the early spring. C. W. Fleming, is superintendent.

TRI-STATE

New Zinc Concentrators Start Production

Domado plant of the Rialto Mining Corporation near Cardin, and the Navy Bean mill of the Eagle-Picher Mining & Smelting Company near Wentworth will add to district's zinc output

▶Starting of two new mills and the expansion of operations at a major producing property of the field, marked the mining activities of the Tri-State district during the closing month of 1940. The two new plants are the Rialto Min-

The Domado mill near Cardin, Oklahoma, of the Rialto Mining Corporation is one of the newest to start operations in the Tri-State district. Zinc ore is hoisted from the 230-ft. level and treated in the mill, the capacity of which is about 50 tons per hour.

ing Corporation's Domado mill, near Cardin, and the Navy Bean mill of the Eagle-Picher M. & S. Co., three miles west of Wentworth. Approximately 200 men were given employment at these two properties. The Domado mill has a capacity of 50 tons of ore per hour, and that of the Navy Bean will rate between 40 and 50 tons an hour. During December, the St. Louis Smelting & Refining Company added another shift to its schedule of operations at its Ballard, or No. 8, property, southwest of Baxter Springs. About 100 men were added to the company's payroll and production of ore was increased from 1,300 to 1,900 tons daily, according to H. H. Utley, district superintendent. These additions to the capacity of the district are expected to increase the weekly output rate to slightly in excess of 9,000 tons, and much beyond that most likely will require a further advance in the price from the prevailing $48 a ton for zinc concentrates.

▶The Eagle-Picher Company has completed the sinking of the No. 2 Blue Goose shaft, midway between the company's Southside and See Sah mines, south of Cardin, according to G. C. Niday, of Miami, Tri-State manager. The shaft is 5x7 ft. in the clear and was sunk to the 325-ft. level, where skip pockets and drifts are being opened. The old Netta steel headframe at the D., C. & E. mine in the Oronogo bottoms is to be dismantled and moved to the No. 2 shaft site, where concrete foundations already have been built. A 600-ton steel hopper from the old Commerce Westside will be installed in conjunction with the headframe.

▶Oldham Mining Company is dewatering a shaft on the Morrison land, a mile northwest of Baxter Springs. A 7-in. Pomona pump, powered by a 40-hp. electric motor, has been installed to dewater the shaft, which is 225 ft. deep. Joe Minnick is in charge of operations, and J. W. Hoffman, of Kansas City, is among those interested in the company.

▶C. C. Playter, of Joplin, has been conducting strip-pit mine operations on the Sea land, south of the old Belville mining camp. A power shovel was used in removing overburden from the strip, which is 10 to 25 ft. in width and about 200 ft. long. Ore is being encountered around the 15 and 20-ft. levels, and is trucked to Waco, where Playter operates a custom mill.

▶Other developments during the past month include the completion of a new shaft by William Graham and C. R. Betz, both of Joplin, on the Freehold No. 3 lease at Waco, and the opening of a new zinc deposit at the 140-ft. level. Charles P. Trammell, of Joplin, and associates have reopened the old Linden mine shaft on the Miller land, a 10-acre tract situated north of Bell Center. Ira Shamblin, of Galena, has reopened the old Mission mine shaft near Lincolnville, and the Bingham brothers—Ralph, Ernest, and Clyde—are working the old Discard mill shaft, south of Baxter Springs, in Oklahoma, which was reopened recently by them. James Osborne, living southeast of Lincolnville, has reopened the old John L. mine, northeast of Quapaw.

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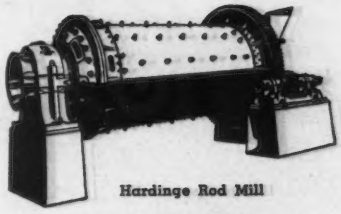
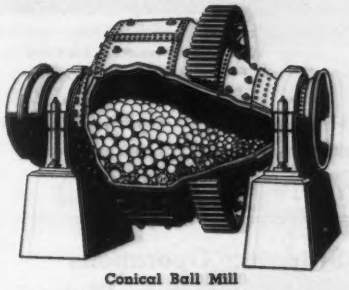


Hardinge Rod Mill



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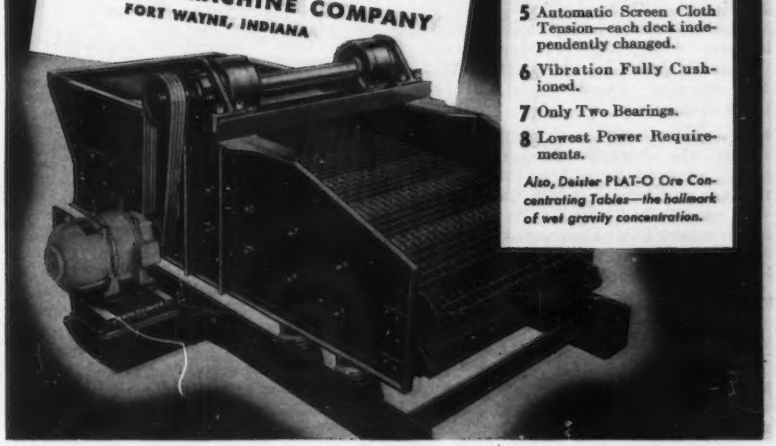

At the Canisteo open-pit mine, Coleraine, Minn., a 1,000 ft. Link-Belt conveyor system was recently installed to convey iron ore from the crushing plant in the foreground to the washing plant at the far end of the conveyor housing.

IRON COUNTRY

Stripping Operations Under Way During Winter

Mining companies on all ranges prepare for the largest production of iron ore in history during 1941

▶ Consumption of iron ore during November was 5,973,007 tons. Stocks on hand as of Dec. 1 totaled 41,711,704 tons. If iron ore consumption continues at the same rate as the last two months, only about 12,000,000 will be on hand May 1, 1941. It is possible that some tonnage will be floated during April, but this depends entirely on weather.

▶ Wilfred Sykes, assistant to the president of Inland Steel Company, predicts that the Lake Superior district would be called on for 72,000,000 tons of ore during the 1941 season, the only question being the transportation by boats.

Mesabi Range

▶ The North Range Mining Company, Negaunee, Mich., of which R. S. Archibald is president, will open the long-idle Schley mine, at Gilbert, Minn. A working agreement has been made with the E. W. Coons Company, Hibbing, Minn., with R. A. MacDonell, Hibbing, Minn., in charge. They plan on stripping 1,000,000 cu.yd. of surface material before the 1941 shipping season. This will be a truck operation.

▶ The Interstate Iron Company will change the method of operating the Grant mine, at Buhl, Minn., from locomotives and cars to truck haulage and will use Walter trucks. At the Hill-Annex mine of this company, at Calumet, Minn., a large stripping program is now in force.

▶ The Canisteo mine, at Coleraine, Minn., continues on a large stripping program and will remove a total in excess of 1,000,000 cu.yd. of surface and rock.

▶ The Charleson Mining Company, Hibbing, Minn., is stripping at the Harris mine, at Aurora, Minn.

▶ Oliver Iron Mining Company is operating several stripping jobs and other work at practically all points on the Mesabi range, giving employment to several hundred men during the winter months. The company also have ordered a lot of new equipment for all the various mines.

▶ A new mine is being opened by the Evergreen Mines Company between Keewatin and Nashwauk, Minn., near O'Brien Brook. E. A. Young, Minneapolis, Minn., contractor, has taken a contract to remove 200,000 cu.yd. of overburden.

▶ A meeting of the Minnesota Section of A.I.M.E. was held in Minneapolis on Dec. 10 at the University of Minnesota. Several good papers were read and discussed.

Cuyuna Range

▶ Pickands, Mather & Company will remove 280,000 cu.yd. of overburden from the Sagamore mine, on the Cuyuna range. A contract for the stripping has been let.

Gogebic Range

▶ About 560 salaried and day employees of the Montreal Mining Company of Wisconsin received a cash bonus for Christmas.

Menominee Range

▶ Operations were resumed at the Tobin mine, near Crystal Falls, Mich., on the Menominee range, by the Republic Steel Corporation on Dec. 9. Ore will be stockpiled until spring to await shipments to the docks at Escanaba. About 100 men are employed. W. M. Webb, with offices at Bessemer and Ironwood, is manager of mines.

▶ The Inland Steel Company, following its policy of adding to its reserves in its long-time planning, recently has acquired the entire holdings of the Nevada Land Corporation, which owned mineral lands in Iron County, Mich.; and, having previously acquired the stock of the Jackson County Iron Company with properties near Black River Falls, Wis., has added to its acreage by purchase of 1920 acres from Jackson County and leasing 320 more. In Iron County the holdings include a third interest in the Balkan-Judson mine, near Alpha and ownership of the Amasa-Porter property. The acquisition in Jackson County contains low-grade ore which awaits proper method of treatment before exploitation for blast-furnace use. A program of diamond drilling is planned on this property. Clarence B. Randall is vice president of Inland Steel, Room 1105, 38 South Dearborn St., Chicago, Ill. Roy L. Wahl is general superintendent of the company's operations at Ishpeming, Mich.

ALABAMA

Iron Mining Operations Virtually at Peak

Steel ingot production in Birmingham area estimated at 2,400,000 tons in 1940—New mining areas being prepared for 1941 production

▶ Iron-mining operations in the Birmingham district are proceeding at peak operations and will enter the new year at 100 per cent capacity. Steel-ingot production for 1940 is estimated at 2,400,000 tons in this area, or a new all-time high. This is indicative of the extent of mining operations which are expected to continue in the new year.

▶ Some concern is being caused by threats of strikes and labor troubles. Red-ore miners of the Woodward Iron Company reportedly voted recently almost unanimously to strike, this coming after similar action by blast-furnace workers, but the furnace workers later signed a new contract with H. A. Berg, president.

▶ The Alabama Supreme Court ruled on Nov. 28 that a shutdown of the Tennessee Coal, Iron & Railroad Company mines in 1939 was caused by a "labor dispute" and that the miners consequently were not entitled to collect unemployment compensation. The miners claimed the company shut the mines down before the old wage and hour contract expired and hence they were thrown out of employment against their will. The high court held, however, that the labor dispute caused the closing.

▶ Shook & Fletcher Supply Company, of Birmingham, is extending its red iron ore stripping operations near Trussville, in preparation to open new areas for production. This concern operates several mines in Alabama.

▶ The second of two informal fact-finding conferences on metal-mining practice was held in the United States District Court Building, Birmingham, Ala., on Jan. 14, 1941, before Harold Stein, assistant director of the hearings branch. The purpose of the conferences, the first of which was held in Salt Lake City, Utah, Dec. 11, 1940, is to assist the Administrator in an equitable solution of the problem of determining just what time must be paid for as "hours worked" under the Fair Labor Standards Act, since varying customs have developed over past years in different metal-mining areas.

MEXICO

Mining Industry Reflects Steadier Outlook

Statements and first acts by Mexico's new President, Avila Camacho, contribute better feeling among small miners and large operators

▶The advent of winter found the Mexican mining industry somewhat more optimistic, largely because of demonstrations President Manuel Avila Camacho made during his first 15 days of office that he is out to the right, as far as he can go, rather than continuing along the leftist lines of the past administration. The industry looks for better times, thanks to the new President. His assurance of full guarantees to private initiative for the benefit of national economy made in his inaugural address pleased the industry. There are indications that labor is not to have its own way so much in the future and that capital intends, in view of the presidential declarations, to open up more in the way of investments. These trends are seen as putting Mexico forward. Interest in Mexican mining developments that some American enterprises have shown of late have also contributed to the industry's decreased pessimism.

▶How foreign exchange, an important business for the industry, will go continues to be a matter of much speculation. Important Mexican bankers believe that the 6 pesos per dollar rate that obtained up to last June is the most satisfactory tariff for Mexico at present. The rate of 4.85 has obtained for several weeks.

▶President Manuel Avila Camacho's first action in aid of cooperative miners was the rushing of assistance in the form of an emergency 350-kwt. electric power plant to the society working El Bote unit of Pittsburgh-Veta Grande at Zacatecas, Zacatecas. The sorry plight of this cooperative was reported to the President by Congressman Aurelio Panames Escobedo, who represents miners' groups. He said that owing to deficient equipment work has been near a standstill for the cooperative for some time and that the 600 miners now only average six pesos ($1.35) a week each. The former weekly payroll of this unit was 100,000 pesos ($22,000). Power equipment is so poor that two shafts of the mine are flooded and water is seeping into the rest of the property. Late in the Cardenas administration the national miners' union arranged that these workers be given definite possession of the El Bote properties.

▶The mining industry is reported to be gratified that Lic. Eduardo Suarez has been retained as Minister of Finance from the Cardenas administration, as the fiscal chief assured the industry that he would do his utmost to aid it in solving its problems, particularly tax burdens. Retention of another Cardenas man, Lic. Ignacio Garcia Tellez, who has been shifted from Minister of the Interior to chief of the Labor Depart-

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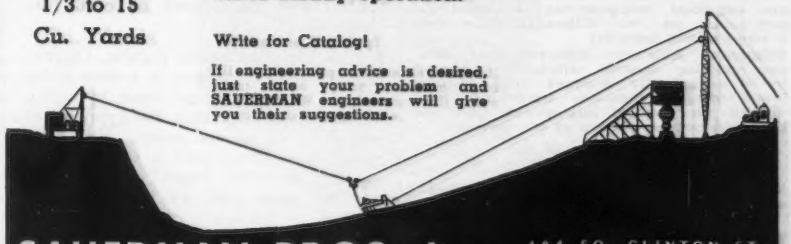

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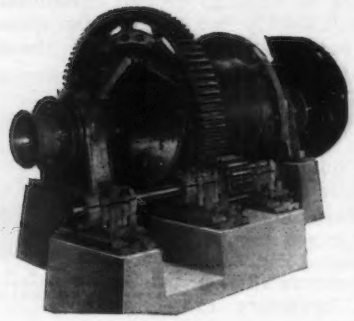

are comments accompanying a recent repeat order for two Williamson Mills from a large mining company.

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▶MEXICO

ment, which is soon to be raised to the status of a ministry, also pleases the industry, as does the appointment of Lic. Francisco Javier Gaxiola as Minister of National Economy. The industry has most of its government dealings with the ministries of national economy and finance and the labor department. It is confident that with the men in charge of these government branches much that is of mutual benefit to the administration and the industry will be accomplished.

▶The timely loan by an important but unnamed mining company spared the National Railways the embarrassment of foregoing its payroll for the second half of November, it was revealed at a meeting of executives of the company with President Gen. Manuel Avila Camacho. The executives remarked that mining continues to be a good friend of the railroad.

▶Potosi Mining, Santa Eulalia, Chihuahua, dodged the danger of a close down because of bad economic times by laying off 300 employees, with the approval of the national miners union. Each dismissed miner was paid a compensation of three months' wages, plus 15 days pay for each year in the company's employ.

▶Success is claimed by the cooperative society of employees, that since June 19, 1937, has been conducting the properties at Pachuca, Hidalgo, from which the Cia. Minera Dos Carlos, S. A., a British company, withdrew because it found the work unprofitable. The cooperative announces a production in 1940, up to Oct. 24, of 3,108 bars of bullion from which were obtained 416.2438 kilograms of gold and 107,613.908 kilograms of silver. The society, which began with 1,200 members, now has 3,500 members. The report claims that the society's weekly payroll is 91,000 pesos ($16,600). The society has assumed control of 75 per cent of the stock of the Cia. Minera Refugio y Virginia, S. A. and is working the Barron and La Blanca mines under lease, the former owned by Cia. Real del Monte, the latter by Jose de Landero. The report avers that diamond drilling has revealed so much good ore that the society will be able to function for many years more. Expenditures of 398,000 pesos ($81,000) were made to improve equipment. The society expects soon to increase its daily milling capacity to 1,250 tons. The cooperative, up to last Aug. 31, paid 451,939.34 pesos for various kinds of indemnifications.

CANADA

Finance Minister Assures All Gold Producers

Industry has preference in allocations of labor and supplies—Large area in Bridge River district, B. C., may be diamond drilled

▶Gold mining was declared an essential war industry, to be given preference in any allocations of labor and supplies, in the budget address of Hon. James L. Ilsley, Minister of Finance, on Dec. 2. The Federal Government declares its willingness to enter into partnership with worthy new properties, while marginal producers may increase the allowance for depreciation and change depletion allowances. Large gold mines will be able to increase output without losing the greater part of the increase, as has been the effect of the prevailing tax rates. This hinted relief in certain cases allows for modifying the excess-profits tax but is expected to be administered by considering each mine on its merits. Broader powers than ever before have been given to the Minister of Finance.

ONTARIO

▶Improved ore conditions at Broulan Porcupine Mines have resulted from the discovery of the No. 6 zone, northeast of the shaft and about 300 ft. from the Pamour boundary. Where explored on the first and second levels, the new ore shows widths up to 10 ft. and a length of more than 350 ft., including indications from drilling. On the third level a crosscut is being driven to the zone. To the south of the main workings favorable ground is being explored by diamond drilling from the 523-ft. level, at which horizon long drifts are being advanced east and west. Ore reserves are sufficient for more than four years' operation of the new 300-ton mill that

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went into production early in December. For the past year Broulan has been shipping to the leased mill of Mace Gold Mines (formerly the Vipond), and from these operations a net profit of $398,590 is reported for the nine months ended Sept. 30 last. Broulan is participating in financing Bonetal Gold Mines, adjoining to the northwest.

▶Hard Rock Gold Mines, Little Long Lac area, plans to have a 100-ton mill addition in operation next spring, after installing a new classifier and ball mill. This addition will treat ore from the old No. 1 shaft workings, as well as ore from quartz veins in the south porphyry zone at the No. 2 shaft. In November the ore grade reached the highest in the mine's history.

▶Depth developments at Coniaurum Mines have extended ore possibilities at this steady Porcupine producer, adjoining McIntyre on the east. In a section east of the Bishop sub-shaft, at the 5,000 level, ore has been drifted on for a length of 170 ft. and has been tested 70 ft. vertically by a raise. This is one of the most easterly orebodies known on the property and is located below the original Rea shaft. Favorable possibilities for exploration have also been found west of the Bishop shaft on the 5,000 level, where a large block of ground below the 3,500-ft. horizon remains to be opened up.

▶Steady progress was made in 1940 at Pamour Gold Mines, controlled by Noranda and located in the East Porcupine camp. Operating costs have been reduced from $2.75 to $2.51 a ton and grade has been improved from $4.47 to $4.66 a ton in recent months, giving net profits higher than in 1939, notwithstanding heavy tax increases.

QUEBEC

▶At Sullivan Consolidated Gold Mines, adjoining the Siscoe, there has been a 10 per cent advance in output, which is more than counteracting the rising costs due to war conditions. The bottom 1,150 level has disclosed a combined ore length of more than 700 ft. in preliminary development in the "A," No. 2, and No. 4 zones, leading to a decision to open two new levels below, from the No. 2 incline shaft. Ore from the main zones in the No. 2 shaft will be sent through the sorting plant as soon as construction work on a conveyor system is completed. In the past the sorting plant has been used only for ore from subsidiary zones in the No. 1 vertical shaft. Labor disputes recently caused a brief interruption of operations, but the matter is now being arbitrated by the Federal Department of Labor.

▶Early in January crosscuting at Lapa Cadillac Gold Mines is expected to reach the new north zone, 450 ft. from the main workings. As explored by a series of nine drill holes, the new zone is typical of the ore structures associated with Cadillac area. More continuity of ore and less intense shearing than has been found in development work to date are conditions suggested in the new area. With ore reserves reduced to one year's supply, and with poor indica-

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▶CANADA

tions below the bottom fifth level, the present program will have important bearing on the mine's future. Quartz is shown to be filling open fractures in graywacke 10 to 20 ft. in width. Eight occurrences of visible gold were found in the drill cores, with the most favorable grading $6 across 22 ft.

BRITISH COLUMBIA

▶During the past summer, examination of the property of B.R.X. (1935) Consolidated, Ltd., in the Bridge River district, and an extensive geological study of that district as a whole, have led to the belief that a new company, the name of which has not been disclosed by the directors, may shortly undertake a diamond-drilling program on the property.

▶Shipment of a car of antimony ore from the Stuart Lake Antimony Mines, Omineca district, controlled by Pioneer Gold Mines of B.C., Ltd., is reported by company officials as being in the nature of a salvage operation. The crew has since been laid off and the property temporarily closed down.

▶A. E. Jukes, president of Gold Belt Mining Company, Ltd., reports that, as of Dec. 13 drifting on the 1,435 vein on the 1,425 level was still in ore. To date, the orebody exposed was 227 ft. long, with an average width of over 3 ft. and an average grade of 0.86 oz. gold per ton. Geological indications are that the orebody being developed on the 1,425 level will continue for a considerable distance beyond the present development heading.

▶Current assets are listed in the annual report of Reeves MacDonald Mines, Ltd., lead-zinc prospect in the Salmo district of the Nelson mining division, as $27,842, of which $26,659.48 is cash in banks. Current liabilities are $346. The property, controlled by Pend Oreille Mines & Metals Company, was inactive during the past year, operations being confined to caretaking and maintenance.

▶The best year in both tonnage and profit is reported by Ymir Yankee Girl Gold Mines, Ltd., gold-silver-lead producer in the Ymir district, for the year ended Aug. 31, 1940. The company realized an operating profit of $145,159, compared with $88,915 for the previous year. Increased operating profit in face of the lowest grade of ore milled in the company's history, 0.236 oz. gold per ton, is accounted for by the salvaging nature of mining operations, resulting in material reduction of mining costs.

▶Milling operations have been resumed at the Kelowna Exploration Company property, formerly the Nickel Plate mine, in the Osoyoos district, following completion of repairs necessitated by the fire which destroyed a large section of the recovery plant Oct. 11.

▶An interim dividend of 10¢ per share has been declared by Mount Zeballos Gold Mines, Ltd. Future dividends will depend on mine results. Assistant Secretary G. F. MacDonnell states that, as of Nov. 1, 1940, ore reserves were 13,111 tons with a cut value of $17.94 per ton, a total value of $235,280.

AFRICA

Sherwood Starr's Ore Reserves Increased

Development following gold-bearing schist near the main vein—Copper companies report satisfactory year

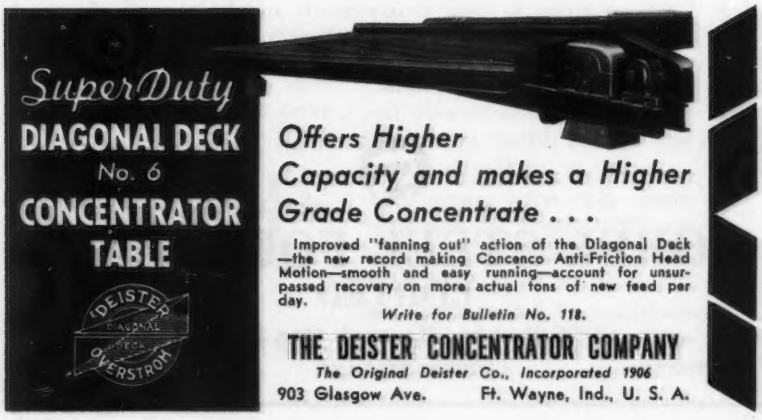
▶A development of possibly far-reaching importance has occurred in Southern Rhodesia. Bailey Southwell, the chairman, stated at the annual meeting that Sherwood Starr's ore reserves are now five years ahead of the mill, this being due to the development of the mineralized schist adjacent to the main vein. It is thought that the possibility of the schists carrying payable values may have been overlooked elsewhere, and many other mines will now start to investigate.

▶Despite the low price at which they sold their production to the British Government, two of the Rhodesian copper companies have reported large increases in operating profits for the year ended June 30 last. Roan Antelope earned, before depreciation, obsolescence, and taxation deductions, £1,843,915, an increase of £245,897 over the figures for the previous year. Since the report was issued it has lent the government £300,000 free of interest for the duration of the war. Expenditure on capital account during the year was £217,061, of which £67,000 was in respect of one-half share of the transmission line between Roan and Mufulira. This line provides for a mutual exchange of electric power in the event of breakdowns.

▶Mufulira Copper Mines increased its operating profit by £566,505 last year, from £1,194,498 to £1,761,003, or by almost 50 per cent. Unfortunately for the shareholders, they received none of the benefit. This was due to the new tax law, which calls for 100 per cent of the profit increase over that of the three years immediately before the war, operates in the case of a company like Mufulira, which was in the early stages of production then, to absorb all additional earnings.

▶Sub Nigel's report shows that a new high record of tonnage crushed, and of profit also, was set up last year. The 3,500 tons per month increase in its reduction plant enabled tonnage milled to be increased by 45,000 tons to a total of 771,800 tons. Increasing depth in the Eastern lease area, where excellent values are being developed, is considered to necessitate a ventilation shaft, which will be sunk to a depth of 3,200 feet.

(*News continued on p. 90*)



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Write for Bulletin No. 118.

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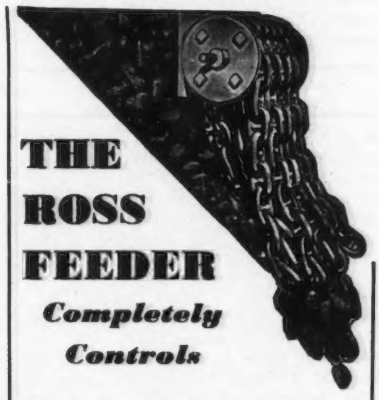

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NEW BOOKS

A TEXTBOOK OF FIRE ASSAYING. *Third Edition. By Edward F. Bugbee. John Wiley & Sons, Inc., New York, N. Y. Pp. 314. Price $3.*

NOW FAMILIAR, this work has been revised and enlarged and is presented as a "contribution toward the scientific explanation of the ancient art of assaying," to quote the author. Mr. Bugbee, who is associate professor of mining engineering and metallurgy at M.I.T., holds to his previous thesis regarding a course in assaying as being the proper place to introduce the student to metallurgy. Prepared on such a basis, the book avoids completely the old "cookbook" presentation of the subject. The man so instructed will understand what he is doing when he gives a particular sample a certain charge and will be able to modify his laboratory procedure intelligently to meet changes in the ores that come to him.

CYANIDING FOR GOLD. *By Ion L. Idriess. Published by Angus and Robertson, Sidney, Australia, and London. Pp. 270. Price 10s.*

THIS book represents an effort to explain to the layman the cyanide process for treating gold ores. The author declares his objective has been to aid the working miner and the small syndicate. The result is a very readable production and one with a greater mass of detailed technical information than one would expect under the circumstances. A seal of approval, so to speak, has been placed on the volume by A. N. Graham, Under-Secretary for Mines, New South Wales. In fact, the author credits the Department of Mines and various individuals of experience with having given him a great deal of assistance.

MINERALS YEARBOOK 1940. *Bureau of Mines, Washington, D. C. Pp. 1514. Price $2. For sale by Superintendent of Documents, Washington, D. C.*

DELAYED several months in publication, this review of the mineral industries for 1939 is now available. The list of items for which only preliminary statistics are available has been whittled down to four — bituminous coal, petroleum, natural gas, and natural gasoline. Final figures for coke, which was in a similar category last year, are included in the present volume. Statistical coverage of secondary nonferrous metals have been revised and extended. Strategic aspects of various minerals are stressed and additional background data are furnished on those for which special studies were made in 1939 for the Army and Navy, in anticipation of defense preparations.

One effect of the European War is the omission of the usual chapter on world production. So many of the European countries have ceased to publish detailed figures covering production and foreign trade that it is impossible to obtain reliable statistics. Looking forward, one may speculate whether next year's volume may not even omit many of the world tables which are still included in individual chapters; 1940 figures may be lacking even for many countries that have managed to maintain their political and commercial existence.

SURVEY OF MINES, 1940–41. *Canada and Newfoundland. Financial Post, Maclean Publishing Company, Ltd., Montreal and Toronto, Canada. Pp. 208, plus 32 pages of maps. Price $2.*

LITTLE can be added to the customary annual comment on this excellent directory of Canadian mines. It continues its practice of reviewing the status of the principal mining companies, and adds pertinent information on the mining industry as a whole. In arrangement and contents it affords as full information as one could desire on mining in the various provinces and in Newfoundland.

▼ ▼ ▼

PUBLICATIONS

RECEIVED

The Clays of West Tennessee. By George I. Whitlatch. Bulletin 49. Division of Geology, Nashville, Tenn. Published in cooperation with Tennessee Valley Authority. Pp. 368, plus maps.

Powder Metallurgy. By Clark B. Carpenter, professor of metallurgy, Colorado School of Mines. A monograph on the subject based on a review of the literature. Colorado School of Mines Quarterly, October 1940, Golden, Colo. Price 50c.

Mining in Malaya. By H. G. Harris and E. S. Willbourn, revised in 1939 by A. G. Macdonald and E. S. Willbourn, respectively Acting Chief Inspector of Mines and Director Geological Survey, Federated Malay States. An illustrated pamphlet of information on the Malayan mining industry. Malayan Information Agency, Malaya House, 57 Trafalgar Square, London, W. C. 2.

Philippine Islands. Mineral resources for the years 1934–1938. Part II—Base Metals and Nonmetallics. Technical Bulletin 13, Bureau of Mines, Manila.

Revisions in Cambrian Stratigraphy of Pioche District, Nevada. By Harry E. Wheeler. Publication of the Nevada State Bureau of Mines, Reno, Nev., pp. 42, price 50c.

Smithsonian Institution, Washington, D. C. Annual report for year ended June 30, 1939. Contains, in addition to formal reports on operations and expenditures, a group of scientific papers on a wide variety of subjects.

Field Tests for the Common Metals, Seventh edition, revised. By George R. Fansett, Bulletin of Arizona Bureau of Mines, Tucson, Ariz., pp. 56.

Geology and Ore Deposits of Northeastern New Mexico (exclusive of Colfax County). By George Townsend Harley. Bulletin 15, New Mexico Bureau of Mines, Socorro, N. M. Pp. 104, plus map.

Contributions to Virginia Geology-II. An indexed collection of eight papers by various authors. Pp. 185 plus maps. Bulletin 51, Virginia Geological Survey, University (post office), Va., pp. 185, plus maps.

Production, Employment, and Productivity in the Mineral Extractive Industries, 1880–1938. By Vivian E. Spencer, W.P.A. National Research Project. Report No. S-2. Publications Section, Division of Information, W.P.A., Washington, D. C.

Labor Law. What the Business Man Should Know of the Labor Law and Its Administration. Management—Its Rights and Responsibilities. By J. Raymond Tiffany and Benjamin Werne. Published by J. Raymond Tiffany, 25 W. 43d St., New York City. Pp. 60. Price 1 to 50 copies, 50c each; 51-250, 40c; 251 up, 25c. First of a series on the labor law. Other pamphlets in preparation will deal with Labor, Its Responsibilities and Obligations; Wage-Hour Act, Unemployment Insurance and Social Security.

Colorado. Preliminary Report on the Gold Hill Mining District, Boulder County, Colorado, No. 4, Vol. 14, Proceedings, Colorado Scientific Society, by E. N. Goddard, associate geologist, U. S. Geological Survey. Pp. 37, maps 4. Colo. Sci. Soc., 515 Custom House, Denver, Colo.

U. S. Geological Survey has issued the following publications obtainable from the Superintendent of Documents, Washington, D. C.: Professional Paper 194, The Gold Quartz Veins of Grass Valley, California, by W. D. Johnston, Jr., pp. 101, with maps. Also Bulletin 922-E, Quicksilver Deposit at Buckskin Peak, National Mining District, Humboldt County, Nev., pp. 115–133, plus map, price 40c. Also Bulletin 922-G, Manganese Deposits at Philipsburg, Granite County, Mont., pp. 155–204, plus map.

Antimony Deposits of a Part of the Yellow Pine District, Valley County, Idaho. A preliminary report. By Donald E. White. Pp. 30. Maps. Bull. 922-I. Price 30c. Superintendent of Documents, Washington, D. C.

Tungsten Deposits of the Atolia District, San Bernardino and Kern Counties, California. By Dwight M. Lemmon and John V. N. Dorr, 2d. Pp. 40. Maps. Bull. 922-H. Price 25c. Superintendent of Documents, Washington, D. C.

Mineral Production of Canada, 1938. Annual Report. Published by Dominion Bureau of Statistics, Ottawa. Pp. 295. Price 50c.

Malartic Area, Quebec. By H. C. Gunning and J. W. Ambrose. Memoir 222, Dominion Geological Survey Memoir 222. Pp. 142, plus maps. Price 50c.

Province of Quebec, Canada. Geological Reports. No. 3, Risborough-Marlow Area, by Carl Faessler; No. 4, Lepine Lake Area, by H. M. Bannerman; No. 5, Fortune Lake and Wasa Lake Map-Areas, by G. S. MacKenzie. Bureau of Mines, Quebec, Canada.

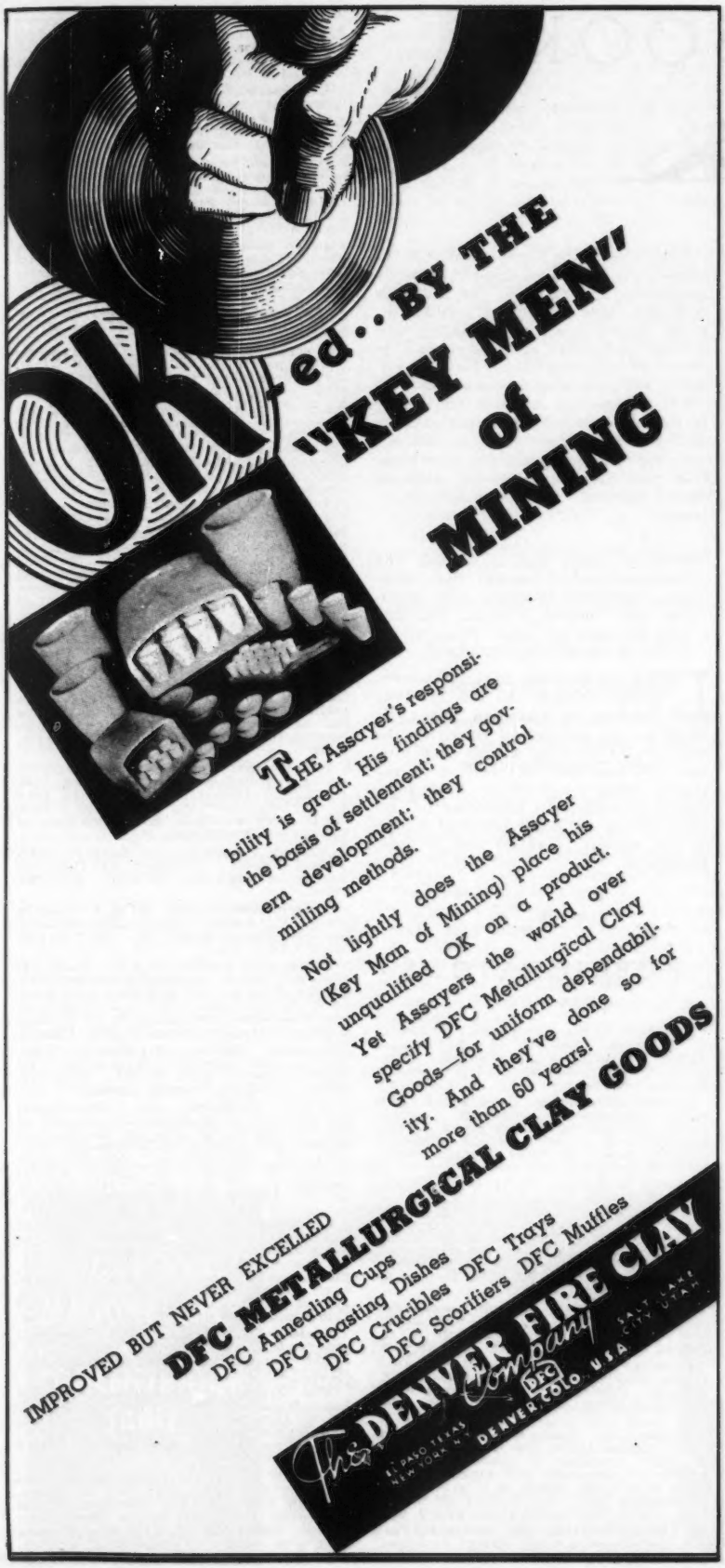
Canadian Bureau of Mines. "Talc, Steatite, and Soapstone; Pyrophyllite." By Hugh S. Spence. Bull. No. 803. Price 50c. Bureau of Mines, Ottawa, Canada.

Brazil. Geological and Mineralogical Survey, of the National Department of Mineral Production, Rio de Janeiro, has issued the following in Portuguese: Bulletin 97, "Marbles of Muriaé, State of Rio de Janeiro," by Alberto Ribeiro Lamego, pp. 47, plus map. Also Bulletin 99, "Geology of the Upper Rio Branco," by Glycon de Paiva, pp. 44, plus map. Also Preliminary Note No. 19, "Age of Calumbi Limestone, of Sergipe" (in the northern petroliferous province of Brazil), by Aristomenes Duarte, pp. 12.: Also Preliminary Note No. 20, "Geology of Northern Coast of Baía," by Jose Lino de Melo Junior, pp. 12. Also, a Geological Map of Brazil and Parts of Neighboring Countries.

South Australia. Mining Review for half year ended Dec. 31, 1939. Bulletin 71, Department of Mines, Adelaide, South Australia. Pp. 125, plus statistical table.

New Zealand. "Metamorphism in the Lake Wakatipu Region, Western Otago." By C. Osborne Hutton. Memoir No. 5, New Zealand Geological Survey, Wellington, N. Z. Pages 84, plus plates and map. Price 6s.

"Dyna." A review issued by the students of the National School of Mines, Medellín, Colombia. The first copy of this publication to be received is dated July-August, 1940, and contains miscellaneous article on economics, engineering, geology, and chemistry.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AUSTRALIA

Gold Output Steadily Climbing Higher

Reports from major mining regions indicate production will be well above that of 1939—Bauxite deposit reported found

Western Australia

▶ Gold yield for the ten months to Oct. 31 was 1,010,734 oz., an increase of 8,220 oz. over the corresponding period of last year.

▶ First Hit Gold Mine (1934), N.L., reports a good development at the 740-ft. level of its mine at Menzies, where in the south drive ore assaying 2 oz. 4 dwt. per ton over a width of 4 ft. was recently found.

▶ Blue Spec Mines, N. L., Nullagine, has encountered what is considered to be its most important development to date in the crosscutting, from a winze at a depth of 82 ft. below No. 1 level, or 244 ft. from surface, of 7 ft. of ore assaying 23 dwt. per ton.

Tasmania

▶ Mineral production in Tasmania for the quarter to Sept. 30 was a record at £A1,017,106. Average number of men engaged in the industry was 5985.

Victoria

▶ Victorian gold yield for October was 12,574 oz., of which the Bendigo field contributed 7,171 oz. The total for Bendigo for the ten months to the end of October is 70,469 oz., over 1,000 oz. greater than the 1939 yield.

New South Wales

▶ Development work at the North Broken Hill mine, Broken Hill, discloses that the orebody is progressing in depth. The main crosscut on the 2,450 ft. level has shown a width of 150 ft. of high-grade ore, and the main haulage drive on the 2,600-ft. level is now nearing a point from which it will be possible to test by diamond drilling.

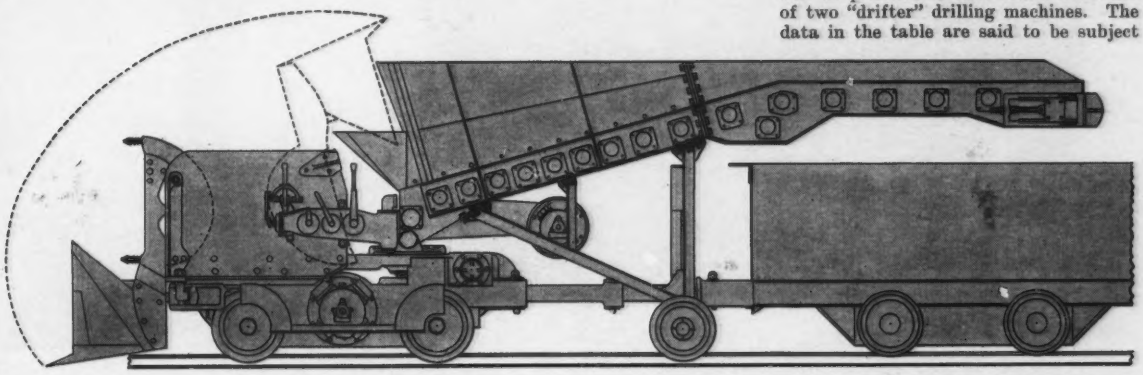
▶ New Butlers Tin Mines, N. L., has been formed to take up 80 acres of tin-bearing ground at Torington.

▶ A discovery of bauxite of reasonably good grade is reported from North Tamborine. Sample from the deposit, which was found by L. C. Ball, chief government geologist, assay 53 per cent alumina.

▶ Tableland Tin Dredging, N. L., Mt. Garnet, treated 726,000 cu.yd. of wash in its small No. 1 dredge during the year ended June 30, and recovered 228.7 tons of tin oxide. Contracts for the No. 2 dredge, which will be about 350,000-cu.yd. monthly capacity, have been placed. Erection is expected to commence next February, and completion is expected early in 1942.

EQUIPMENT NEWS

New Electric or Air-Operated Loading Machine



EIMCO Corporation, of Salt Lake City, announces the development of a new mucking machine, known as the "Tunneloader," which is said to have a number of new features which permit loading the largest cars used underground with speed and economy.

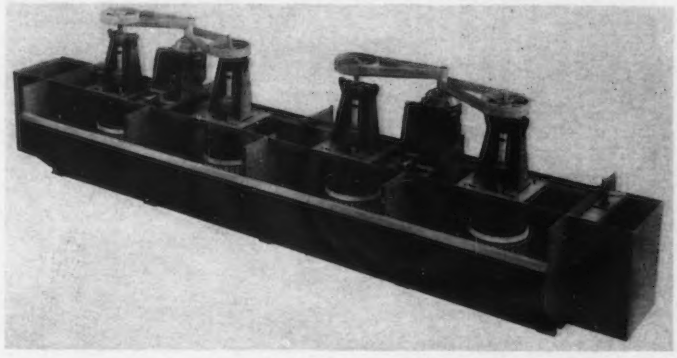
As indicated by the accompanying illustration, the Tunneloader retains the Eimco-Finlay rocker-arm mucking action —crowding the bucket into the muck pile by its self-tramming power, and rolling the bucket-and-rocker-arm assembly over backward on a supporting track to its dumping position against the bumper springs. In the Tunneloader, however, two important improvements are reported made in the mucking action—one of which is the introduction of a separately powered self-locking worm-and-gear mechanism for swinging the bucket assembly to any desired digging position without manual effort by the operator. The other is elimination of any need for "centering" the bucket assembly before dumping. This latter advantage has been made possible by the introduction of a hopper into which the bucket discharges direct from any digging position instead of dumping into a car, and having to be lined up with it first, as with the smaller-sized Eimco-Finlay loaders.

The use of a hopper, which feeds the rock onto a short belt-conveyor, permits loading cars having bodies up to 15 ft. in length and 6 ft. in height above the rail. The conveyor is separately powered and can be started, or stopped, by the loader operator from his normal operating position. He can also vary its speed within a wide range by the same conveniently located control lever.

Normally the car to be filled is coupled to the loader as shown in the illustration. Uniform loading of long cars is assured by use of a long coupling bar, which slides in a sleeve cored throughout the length of the loader frame and which is provided with a number of "spacing holes" for the coupling pin so that the position of the car with respect to the loader can be varied as required. If desired, however, the car can remain attached to a locomotive and kept spotted under the conveyor discharge by the locomotive operator. A feature of the Tunneloader is said to be its moderate weight (about 12,000 lb.) in comparison with its high loading capacity, of more than three tons per minute. This advantage has been achieved partly through relatively simple design and construction but also by the liberal use of heat-treated alloy-steel castings and forgings for all highly-stressed parts. Other practical operating advantages include sectionalized construction, which permits traveling around relatively sharp curves, easy disassembling for transportation or caging, surprisingly moderate headroom requirements, and very low cost operation and maintenance. The four motors (tramming, bucket-elevating, bucket-swing, and conveyor) can be either the radial compressed-air type shown in the illustration or electric motors of any standard characteristic. When compressed-air motors are used, the average air consumption at 70 to 100 lb. pressure should not exceed that of two "drifter" drilling machines. The data in the table are said to be subject to some variation because of the ease with which the design can be modified to meet special requirements. All distinctive features are protected by patent rights in the United States and other countries.

Weight, complete, approx.	12,000 lb.
Length, over all	23'-9"
Height, over all	6'-8"
Headroom required, for operation	7'-6" to 7'-10"
Width, over all, of hopper	6'-8"
Digging width	11'-0"
Bucket capacity, water measure	9 to 12 cu.ft.
Loading capacity, cu.ft. per min.	50 to 75
Motors, horsepower, air or electric	
Traction	18
Bucket elevation	18
Bucket swinging	6
Belt conveyor	6
Range of track gage	30" to 56½"
Size of car body loaded	up to 6 ft. high x 15 ft. long

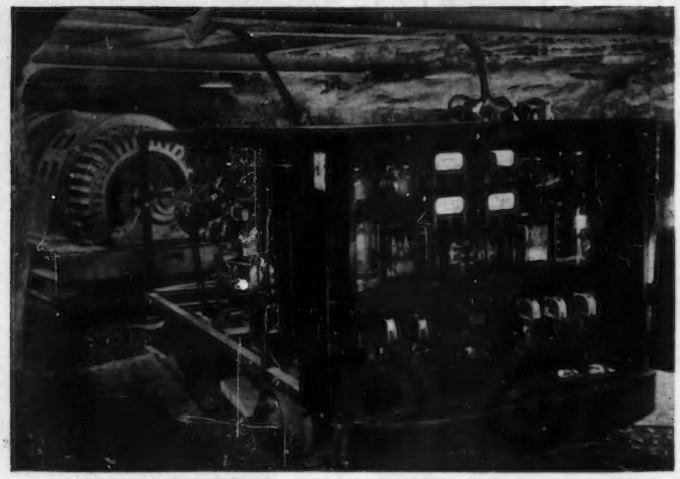
New Type Fagergren Flotation Machine



AMERICAN Cyanamid Company, New York, announces a new level type Fagergren machine that differs from the older types in two major respects—namely: (1) It operates on the level, thus eliminating the necessity of the drop between cells. (2) The "clover leaf" which provided the recirculation in the older types of machines has been eliminated, and instead the rotor-stator assembly has been raised from 2 to 4 in. off the bottom of the tank, depending on the size of the machine. By the elimination of the "clover leaf" the tank construction is said to have been simplified considerably and more recirculation now takes place within each cell.

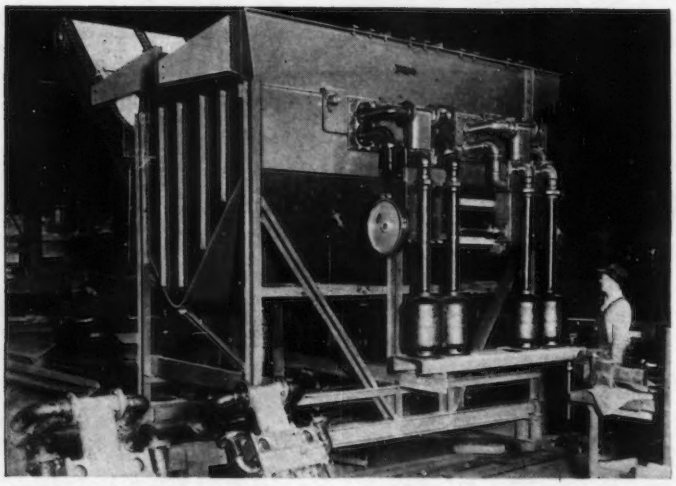
Other features include the provision for adjusting the level of the overflow lip by means of inserting "slats" into the overflow weir, and froth overflow weirs have been inserted in the partitions between cells. These latter weirs make it possible to confine the froth within the limits of each cell, or, alternately, by adjusting the height of these weirs, it is possible to "countercurrent" the froth. Two- or four-cell units are available.

Portable Mining Switchgear



NEW unitized automatic switchgear, for controlling synchronous-motor-generator substations in mining service, is announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This equipment can be arranged for mounting on a portable truck or car so that it may be moved right along with the load center. Such portability reduces installation costs by requiring less length of distribution feeders; it also results in less voltage variation at the load. Available for standard operation from a 2,300-volt, 60 cycle a.c. supply, and with a 275-volt d.c. output. It can also be obtained for other standard voltages. The switchgear provides for the starting, stopping, and running of the motor-generator set. The operation of the switch or pushbutton is the only manual one required. Starting and stopping sequences are said to be fully automatic and are accomplished by means of control relays on the switchgear itself. Complete protection against overload, short circuit, faulty equipment, and improper running conditions is said to be provided during the full operating cycle. Units are available for controlling single and double unit substations.

New Conset Jig



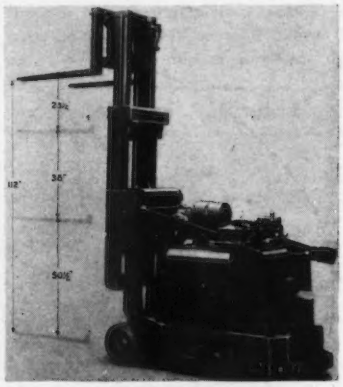
ALLIS-CHALMERS Mfg. Co., Milwaukee, Wis., announces a new Conset jig—an ore-concentrating jig operating on the principle of controlled settling. This consists of the accurate control of the stroke cycle to produce a differential pulsion and suction, permitting a longer period of settlement. The pulsion member consists of a rubber envelope actuated by the entrance and agress of low-pressure air.

The air flow in this device is controlled by a valve device which can be manually operated to alter the air-flow cycle, producing a controlled and differential stroke cycle. For use in closed circuit with grinding mills, a Conset gold jig has been developed in addition to the Conset ore jig.

The Conset principle applied to the jigging of fine unsized material in the mill discharge produces a high-grade concentrate of valuable sulphides and fine gold before further grinding may slime or alter the valuable mineral. Some units are employed in the Iron Country for the beneficiation of low-grade iron ore.

Triple Lift Fork Truck

ELWELL-PARKER Electric Company, Cleveland, Ohio, announces a new type of fork truck, the ERS-3T, capable of elevating loads on skids or pallets to three levels instead of one. The elevating mechanism is built in three telescop-



ing sections. When uprights are completely lowered, the forks clear the floor. At the operator's will, forks can be raised to 50½ in. on the first lift, to 88½ in. on the second, and to 112 in. on the third. The rate of upward travel is 20 f.p.m. with a 1500-lb load. With telescoping members lowered, the over-all height of the truck is 74 in. Thus the loaded truck can pass through doorways or beneath low overhanging pipes or conveyor systems. The main driving motor is an Elwell-Parker 4-pole, series-wound, said to be capable of sustaining a 500 per cent overload. It is direct-connected to a free-coasting worm and gear, and drives the two wheels nearest load, assuring ample traction. Power source can be either acid or alkaline storage batteries. When lowering load, regenerated power is returned to the battery. The hoist is operated by a separate motor controlled by pushbutton. It may be tilted 15 deg. backwards or 5 deg. forward from vertical.

Screw Classifiers

WESTERN MACHINERY Company, 760 Folsom St., San Francisco, Calif., announces a new line of screw classifiers of the simplex- and duplex-screw, and the single- and double-pitch screw, types. The classifier flights are equipped with wear-resistant shoes that are said to be easily removed. Screw diameters range from 12 to 96 in. and capacities are said to reach, in sand raking, up to 10,000 tons per day with single screw. Overflows range from 10 to 325 mesh and operations are said to be efficient on light or heavy medium.

The units are equipped with a device that raises or lowers the flights by means of either a motor-driven or hand-operated mechanism. Operating advantages listed by the manufacturer are (1) steep slope with no sand backslip; (2) operation in close circuit with any grinding mill; (3) low head losses; (4) no surge; (5) no stalling when overloaded; (6) efficient at high densities; (7) low costs per ton handled; and (8) little floor space.

A traveling grizzly feeder designed to convey large rock to a crusher and bypass small rock and dirt around the crusher is announced by the Pioneer Engineering Works, Inc., Minneapolis, Minn.

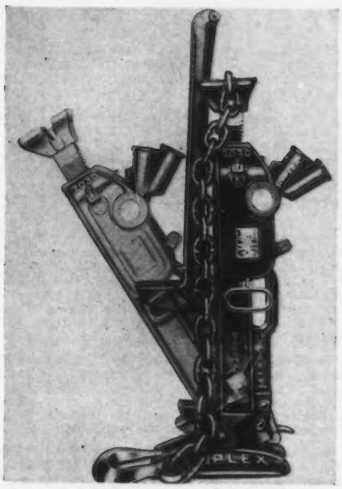
New D-C Recorders

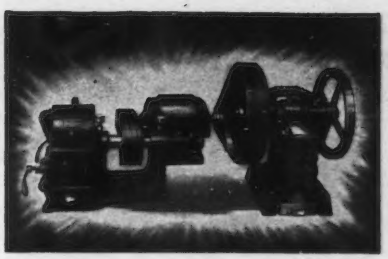
GENERAL ELECTRIC Company, Schenectady, N. Y., announces that its Type CF line of inkless recorders has been extended to include direct-current instruments (Type CF2) available as voltmeters, ammeters, millivoltmeters, milliammeters, and even microammeters in ratings down to 125 microamperes full scale. These new CF2 instruments are said to make it economical to apply recording instruments to many applications where previously the expense of suitable equipment could not be justified. Because of their inkless operation, they are said to be ideal for general testing purposes and for use on moving vehicles —such as trains, trucks, and buses—for studying generator performance, battery load, and speed.

The CF2 recorder is portable, may be wall or pole mounted, and is suitable for indoor or outdoor application. Providing continuous operation for 30 days without attention, it is ideal for installation where frequent servicing is impractical. It may be operated at temperatures ranging from —10 F. to 120 F. The electric element, as well as all other moving parts, is housed in a modern, weatherproof case of aluminum-alloy casting. Accuracy is within 2 per cent of full-scale value.

20-Ton Emergency Jack

TO MEET THE NEED for an emergency jack, Templeton, Kenly & Company, Chicago, Ill., have introduced a model that is said to have a full 20-ton lifting and





For SPEEDY Sample Reduction

The Braun UA Pulverizer and Chipmunk Crusher with Close-Coupled V-Belt Drive

Efficient, up-to-date equipment is essential in today's busy metallurgical laboratories, where neither time nor labor may be wasted. The Braun UA Pulverizer and Chipmunk Crusher V-Belt Assembly Unit is a convenient and compact arrangement of these two indispensable machines which saves space in your laboratory and saves both time and labor.

This assembly utilizes a modern, close-coupled V-belt drive which eliminates power-wasting, dust-catching, uneconomical overhead shafting with its attendant mechanical hazards. Efficiently engineered and sturdily built, this speedy sample reduction assembly stands up amazingly under the gruelling day-in and day-out punishment of hard rock crushing and grinding.

Install this modern assembly in your laboratory now. Write Dept. E-1 for Bulletin C-124 today.

BRAUN CORPORATION
2260 EAST 15TH ST. LOS ANGELES, CALIF.
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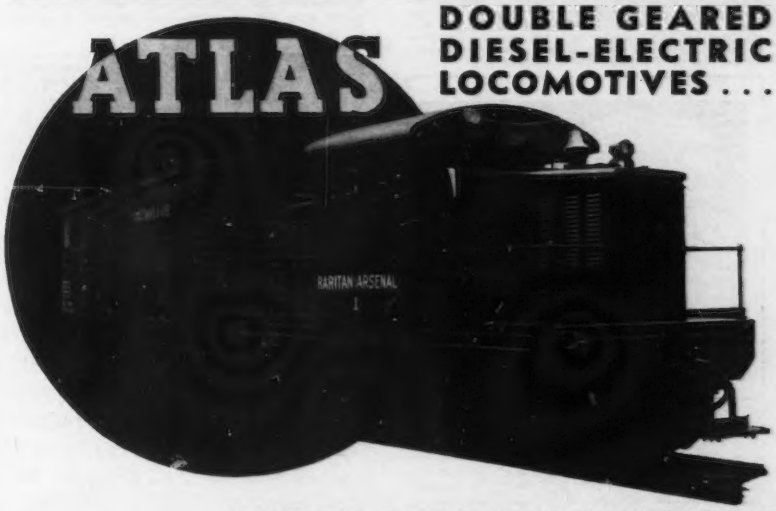
ATLAS

DOUBLE GEARED DIESEL-ELECTRIC LOCOMOTIVES . . .



. . . HIGHLY EFFICIENT UNITS FOR ALL TYPES OF MINE HAULAGE SERVICE

Atlas Double-Geared Diesel-Electric Locomotives permit low-cost mine switching service. Double reduction spur gearing, totally inclosed, gives them exceptional pulling ability in relation to their total horse power. Entire drive is a self-contained power plant—no outside shafts, universal joints, or other mechanical connections. For performance in regard to price, you can't beat these locomotives . . . they can be used on track as narrow as 36" gauge, at speeds up to 20 M.P.H. Write for complete details.

THE ATLAS CAR & MANUFACTURING COMPANY
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THIS WEIGHING FEEDER

Stands rough treatment and remains accurate, because it operates on the compensating balance belt principle.

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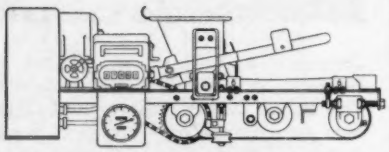

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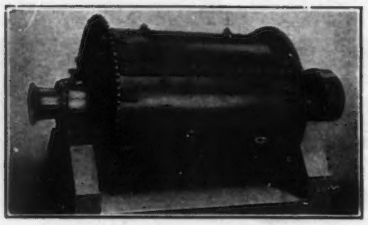
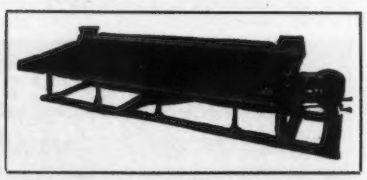
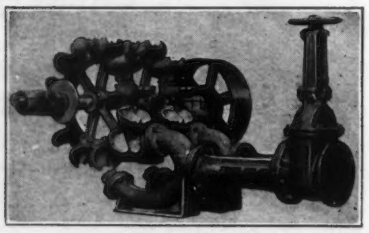


Super Giant Mill with central discharge head for external classification. Chain drive is standard for this mill . . . . gear drive is available. Sturdy, all-steel construction. All structural parts are carefully machined to gauges. Grinding ability of this size mill is unsurpassed. Get facts today. Ask for catalog #302.



Mine owners report this Overstrom Universal concentrating table can't be equalled in capacity, saving or uniformly clean concentrates. Sturdy—adaptable—simple—reliable—the Overstrom table comes in many different sizes and capacities. Get performance records.

The famous Kue-Ken Balanced Crusher. Tried and tested in mines throughout the world . . . . . write for owners reports of this amazing crusher. Greater capacity, less power requirements, less wear than any crusher on the market today. Information on field performance is given in Bulletin #39. Write for it today!



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STRAUB MFG. CO.
516 Chestnut St. Oakland, Calif.

holding capacity on either the cap or toe lift of the jack. Designated No. 2030, this jack is 30 in. high, has a full 17¾ in. lift, and weighs 167 lb. with complete equipment. Besides lifting on cap and toe, it lifts on the auxiliary shoe, which hooks into the cap, or on the chain with grab-hook end, any link of which can be engaged with the recess in the cap.

Besides lifting and lowering vertically, this jack tilts on its base for jacking at an angle. The tilting pawl can be released by the operator's toe. It can also be used horizontally for pushing, spreading, or pulling by using the chain.

Light-Weight Scraper Hoist

INGERSOLL-RAND Company, Phillipsburg, N. J., announces a new scraper hoist that is claimed by the company to be the lightest and most compact double-drum scraper hoist ever built. It weighs 250 lb. (without cable guides), and its compactness will allow it to be passed through an opening 13x15 in. This unit was designed especially for small scraping jobs in thin, narrow veins or stopes, irregular veins, crosscuts, for spreading wastes, for development work, and like applications. It is said to have a cable pull of 650 to 1,000 lb. and a cable speed of 125 to 150 f.p.m. Either air or electric drive is available.

Construction details include: An individual clutch lever control for each drum. No tools are required to make a clutch adjustment, which is external and easily made by hand. All gears are totally inclosed and operate in a grease bath. Anti-friction bearings support all rotating parts. Helical stub-tooth gears provide smooth, quiet operation.

BULLETINS

Bearings. Link-Belt Company, 307 N. Michigan Ave., Chicago, Ill. Catalog 1775 describes and illustrates the manufacturer's anti-friction roller bearings and ball bearings in various styles of housings. The complete line has been renamed "Friction Fighter" bearings. Complete tables of sizes, dimensions, weights, and list prices are given. Pp. 88.

Pyrometers. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y. Catalog 1101F describes and illustrates the manufacturer's Electray pyrometers for use in various industries. Pp. 34.

Steel Balls. Hadfields, Ltd., Sheffield, England. Bulletin 443 describes the manufacturer's hard forged steel balls for ball and tube mills. Pp. 2.

Steel Shapes. The Colorado Fuel & Iron Corp., Pueblo, Colo. Catalog 202 is a comprehensive vest-pocket edition of the manufacturer's line of fabricated, hot-rolled steel shapes. Considerable engineering data and general information for engineers and designers is found in this small book. Pp. 96.

Thermometers and Pressure Gages. Brown Instrument Co., Wayne and Roberts Ave., Philadelphia, Pa. Catalog 6706 describes and illustrates numerous industrial uses of the manufacturer's temperature and pressure gages. Pp. 20. Catalog 2007 describes the company's electric flow meters. Pp. 27.

Insulating Fire Brick. A. P. Green Fire Brick Co., Mexico, Mo. Bulletin has technical data on the company's insulating fire brick. Pp. 7. Company also offers bulletin on "Airset," an air-setting high-temperature bonding mortar. Pp. 4.

Electrostatic Voltmeter. General Electric Co., Schenectady, N. Y. GEA-3020A describes and illustrates a portable elec-